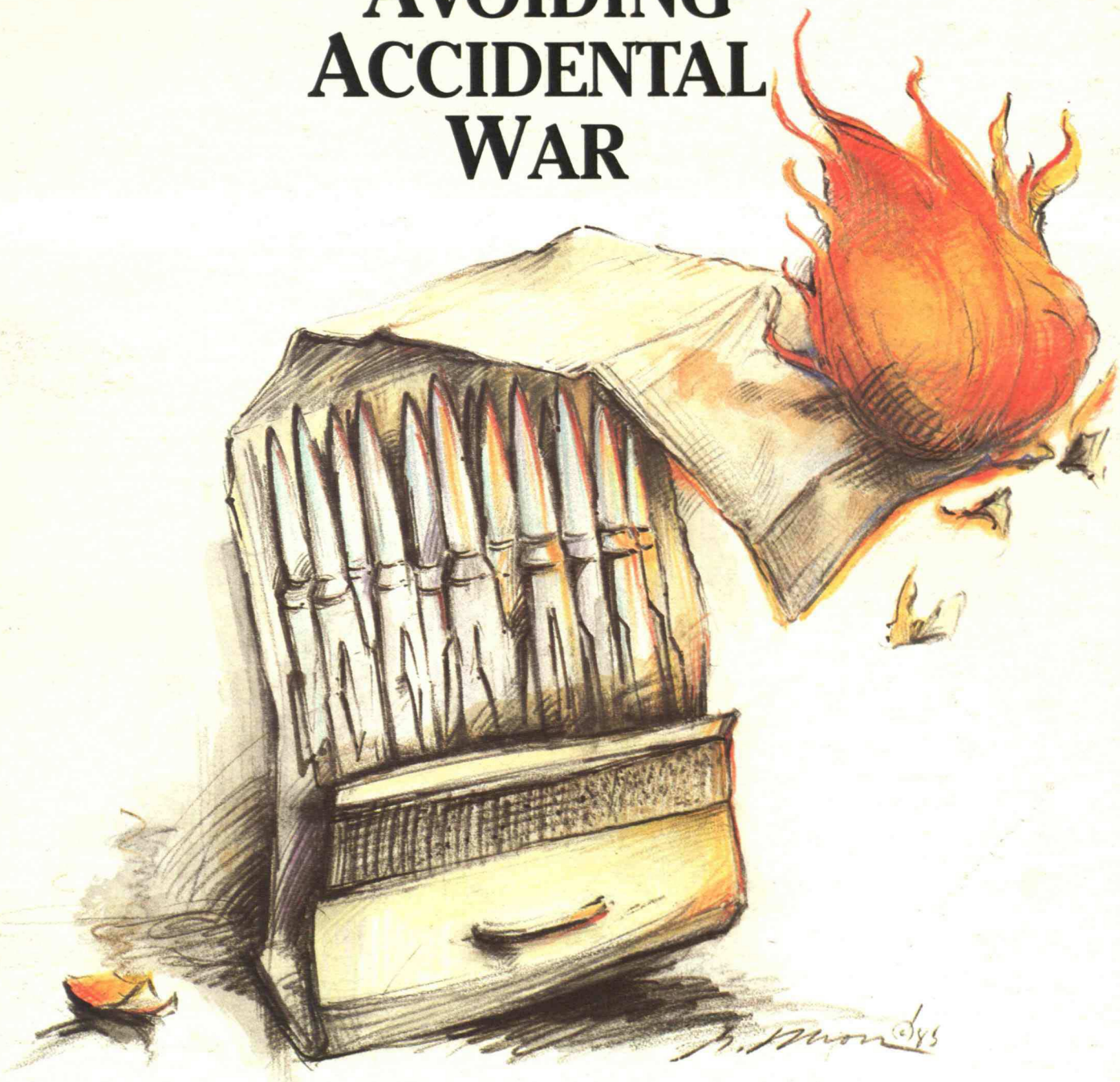
HOW CRITICAL ARE CRITICAL METALS?

LESTER THUROW ON A NEW INDUSTRIAL POLICY

Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AUGUST/SEPTEMBER 1985 $3.00

AVOIDING ACCIDENTAL WAR



■ *ALSO:* BIOTECH'S POTENTIAL FOR WORLD HEALTH ■

technology
review
Published by MIT

"VAX IS GIVING AMF MORE TIME FOR THE THINGS THAT REALLY MATTER."

Michael Lilly
Director, Corporate MIS/Operations
AMF, Incorporated

To many people AMF means recreational sports. But today it also means electronic components, filtration equipment, automated process equipment and more.

It's a vastly more complex company. A company made vastly more manageable by Digital's VAX™ computers – the vital component of office automation at AMF Corporate/MIS Operations.

As Michael Lilly says, the company's decision to stake its future in MIS on Digital's VAX computers – and the office automation tools like ALL-IN-1,™ DECnet™ and DECmail™ software that run on them – was hardly a snap judgment.

Every major computer company was considered. Lilly says that, "dollar for dollar," only Digital's VAX system offered the power, ease of use and communications capability with other computer systems – including IBM – that AMF needed.

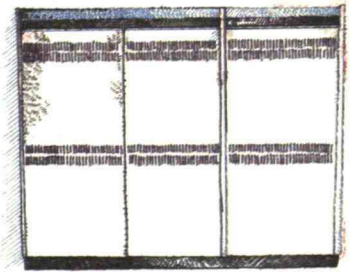
So AMF chose the VAX computer – the best-selling 32-bit computer in the world – and waited to see what the machine could do.

"SUDDENLY WE HAVE TOOLS AND CAPABILITIES WE NEVER HAD BEFORE."

Lilly and his group didn't have to wait long. The system was up and running within days.

Reaction within the department was rapid and gratifying. "We really got excited about it," says Lilly. "Immediately, we were communicating better." And there was more – spreadsheets and word processing and a mail system. "Suddenly," Lilly said, "we had a vehicle for total open communications to every important person or department in the corporation."

Part of the story behind AMF's almost instantaneous rapport with the VAX system is that it's so easy to use. Menus and operating commands are the same for each fully integrated application. Whole functions are completed in as few as two keystrokes. And because everything is in plain English, it's literally as simple as A-B-C to incorporate



any VMS™ application into the daily work routine.

"INSTEAD OF SIX WEEKS TO DEVELOP AN APPLICATION, IT TAKES TWO."

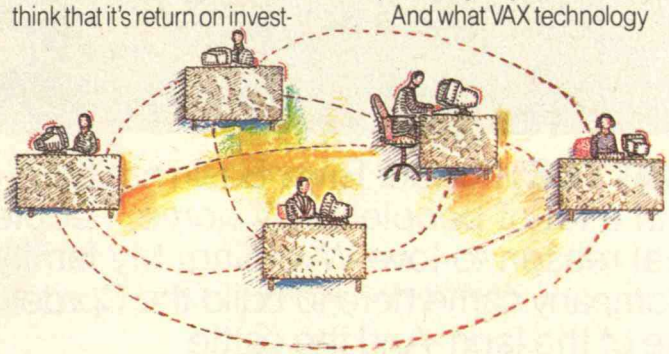
VMS software development tools have so improved the way things are done in his department, Lilly says, that he projects the savings in applications development time and costs alone at some 70 percent.

"Many of our new applications here at AMF will be written on that machine. I can't quantify it exactly. All I know is that I'm getting a heck of a lot more bang for my buck."

The first tests of VAX equipment proved so successful, that AMF quickly enlarged the system, adding terminals and DECmate™ and Rainbow™ personal computers. New departments went on line, for example finance.

"And that," says Lilly, "really created an explosion." Now AMF is implementing programs like general ledger systems, stock options and inventory systems, and keeping more efficient and flexible records, from accounts payable to personnel.

Adds Lilly, "People here are screaming to be on the VAX system, and there's got to be a reason for that. And I tend to think that it's return on investment, mailing lists, discounted cash flows, spreadsheets they couldn't even begin to do before, versatility, tremendous graphics potential. It's just a whole world of opportunity that is elevating AMF to the forefront."



"ANYONE WHO USES VAX IS GOING TO GET THE COMPETITIVE EDGE."

Lilly feels the VAX system has already elevated his own department to the forefront.

"It's put corporate MIS on the map," he says. "It has effectively increased productivity and efficiency. People are beginning to believe we can do the things we say we are going to do."

And what VAX technology is doing for his group, Lilly believes, it can do for all of AMF, or indeed for any company. "Any corporation that employs this technology," he says, "is going to get the competitive edge.

"This technology will explode. Because there are a thousand reasons to have it. But what it really all boils down to is this: everybody will want a VAX system because they can do the job better, faster and more efficiently.

"And that's what really matters."

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Dwight Knott, Sun Company manager of the Big Horn Ranch and Reclamation Research Center.

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"I've got a special reason to love Wyoming. My family homesteaded this land. So when Sun Company came here to build the Cordero coal mine we wondered about the future of the land. And the cattle.

"But Sun also started a Land Reclamation and Research Center. Today our experiments are making sure the land and cattle are in better shape than ever.

"I run the place. So I'm part of Sun's future. And Wyoming's."

At Sun we think putting our energy back into the land is just as important as getting it out.

WHERE THERE'S SUN THERE'S ENERGY.

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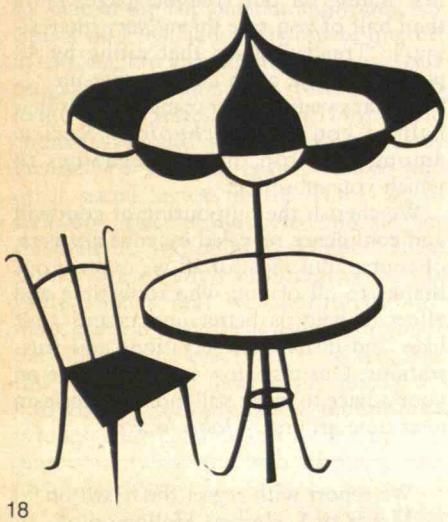

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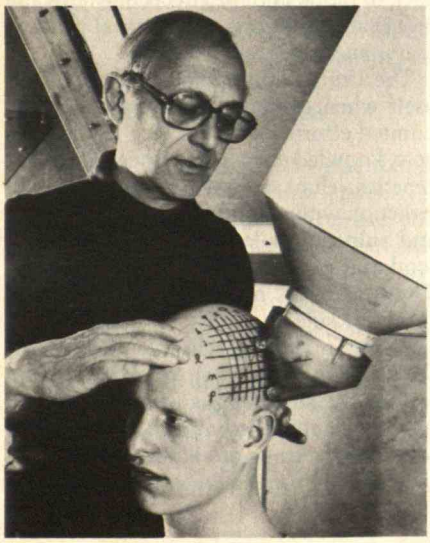

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What You Told Us

EARLY this year we asked some 650 *Technology Review* readers about their stations in life, their reading habits, and their likes and dislikes in the magazine. Nearly 400 of you replied—a high rate of return that is itself a vote of confidence in which we rejoice.

Here's a brief summary of what you said.

In the vernacular of the media business, the *Review*'s is an "upscale" audience—average income $80,400; median income $61,500. Over 81 percent of you are owners of homes, and their average value is $185,000. Over 90 percent of you are college graduates, and nearly 60 percent have graduate degrees.

Just under 25 percent of you read *Time*, 20 percent *Scientific American*, and 18 percent *National Geographic*; no other magazine claims more than 13 percent of our readers. On average, you refer to each issue of the *Review* 2.6 times during its life on your shelf or coffee table, and in your enthusiasm you share your copies of the *Review* with friends and colleagues to bring our total readership per issue to over 140,000. Fully 70 percent of you said "just right" in response to a question about our level of technicality.

Our best-liked features are the "major articles"—the essays by scientists, engineers, and policymakers to which we give first billing on our contents page; more than half of you rate them "very interesting." "Trends," given that rating by 48 percent of you, are a close runner-up.

Perhaps your highest compliment is that half of you rate *Technology Review* among the "top three" magazines to which you subscribe.

We cherish the outpouring of goodwill and confidence revealed by your answers, of course. But most of all we express our thanks to all of you who took time and effort to help us better understand your likes and dislikes, expectations and frustrations. Our task now is to capitalize on your advice to merit still more enthusiasm next time around.—*John Mattill*

We report with regret the death on May 8 of J. Herbert Hollomon, director of the Center for Technology and Policy at Boston University. Professor Hollomon's membership on *Technology Review*'s Advisory Board dates to 1970, when as a member of the M.I.T. faculty he founded the Institute's Center for Policy Alternatives. We all remember his pungent yet supportive role in the board's deliberations for much of the past 15 years.—*J.M.*

LETTERS

Support for Environmental R&D

Most of the priorities of presidental science advisor George Keyworth II for science and technology policy make very good sense. (*See "Science and Technology Policy: The Next Four Years," February/March, page 44.*) Encouraging basic research in fields such as astronomy and physics that do not directly benefit the commercial sector is an example. Stimulating industry to do long-term planning is also healthy. Bell Telephone Laboratories' R&D facilities produced the world's best telephone system through long-range planning without government support. Dr. Keyworth can do much to help establish favorable conditions for similar activities in other sectors.

But he overlooked a major category: environmental R&D, which may be either long-range or short-range but benefits society immensely while attracting funding from industry. In the United States, such research includes work on hazardous-waste disposal, the effects of CO_2 on climate, soil degradation, air pollution, dieback of biota, and the effects of energy use on urban conditions, agricultural productivity, and U.S. trade.

The United States should also concern itself when these problems exist abroad. Limited efforts are under way to combine new knowledge in bioengineering, plant genetics, climate, and environmental interaction with on-site programs in tropical and subtropical lands to produce better food and materials in more benign ways. These projects merit vigorous support from our side.

For example, a much-discussed issue is the problem of wood stoves in rural tropical areas. New designs of stoves are not only more efficient but also reduce ill effects on the lungs of village women. Not of interest to top American scientists? Not

so. One of the 100 outstanding young scientists of 1984 had a passionate interest in this. He ran a small but vigorous R&D program on wood stoves. Not important to the United States, and thus Third World countries should study these problems themselves? Not so, either. Health and other social factors in the Third World seriously affect productivity, morale, social welfare, and political stability. These topics are of such importance to the United States that we appropriate vast funds to deal with them using more martial and often less effective ways. The United States can more easily supply the knowhow and advanced technology through truly collaborative programs that most countries would be hard-put to supply themselves.

David J. Rose
Cambridge, Mass.

The writer is professor in the Department of Nuclear Engineering at M.I.T.

Low Tech for China

I agree with Denis Fred Simon (*"Technology for China: Too Much Too Fast?", October, page 38*) that the United States is giving too much to China in return for too little. My firsthand observations also indicate that the Chinese have a much greater need for low-tech fundamentals in all areas of technology than for high-tech sophistication that they cannot yet really cope with. Given the foreign competition in supplying technology to China, one might suggest that it is better for the United States to follow its present course in an effort to obtain the inside track. Clearly, however, this is risky.

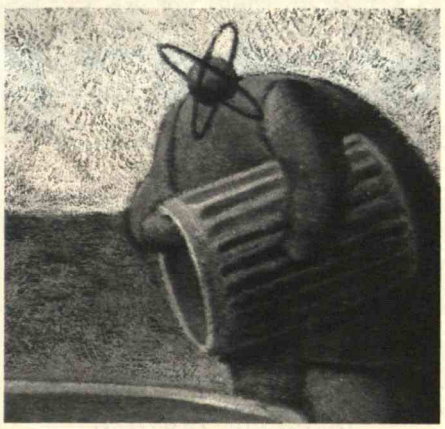
James V. Hamel
Munroeville, Pa.

Public Transit in Ottawa

"Ottawa Builds a Busway" by David Kennedy (*November/December, page 71*) sounds like a public-relations release. Our family has no car and we depend heavily on the bus system. Canadian riders pay such a high percentage of the busway's operating costs because we have the highest fares in North America. Adults pay $.90 a ride and unlimited service in the city costs $30 a month. Trips to the outlying suburbs cost extra.

The cost of the system is at least 100 percent over original estimates. In fact, some area politicans now admit that no one really knows how much the complete system will cost. Furthermore, the system is primarily geared to bringing suburbanites to the center of town, despite the fact that the high-tech industry is in a western suburb. Service is worse for those living near the center of the city. Maybe the bugs in this system will be eliminated. In the meantime, we are paying dearly for worse service.

Irma Cohen
Ottawa, Canada



Disposing of Nuclear Waste

Much too little attention is being given to temporary storage as a sensible alternative to permanent disposal of long-lived toxins, as Victor Gilinsky describes in "A Common-Sense Approach to Nuclear Waste" (*January, page 14*). Your magazine was one of the first to discuss certain aspects of this problem when it reported on my paper in "Space Disposal of Nuclear Wastes: Keep the Option Open" (*July 1981, page 84*). My conclusion was that space disposal—although not practical, economically viable, or safe enough now—would be a very real alternative in 50 to 100 years. This position was later endorsed by the American Institute of Aeronautics and Astronautics.

Compared with the half-lives of nuclear waste, that is a very short time indeed. Temporary storage of wastes is therefore reasonable. Unfortunately, as Gilinsky notes, the powers that be choose to overlook this alternative and other forms of permanent disposal that may become available in the longer term.

Stanley G. Rosen
Colorado Springs, Colo.

ILLUSTRATION: ROB COLVIN

ROBERT C. COWEN

Degrees of Freedom

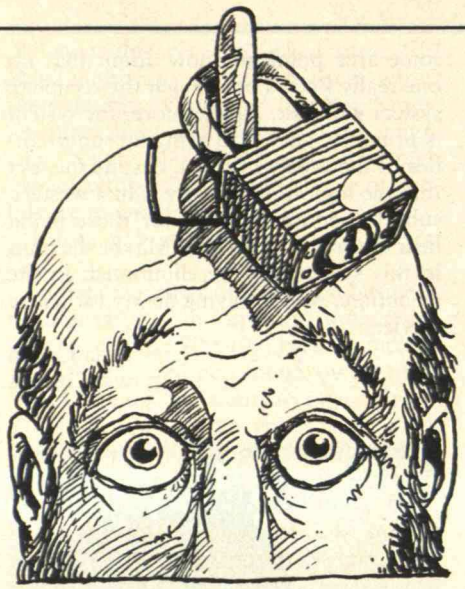
RESEARCHERS on U.S. campuses usually consider the freedom to publish their work and discuss it with both domestic and foreign colleagues to be a basic and essential right. Yet some of them, at least, face a dilemma when this once-unquestioned freedom conflicts with other concerns.

For example, the U.S. and Soviet academies of science have recently discussed the details of an agreement to renew scientific exchanges. Is this "a promising footbridge" on the tortuous path toward reducing tensions between the two countries, as William D. Carey, executive officer of the American Association for the Advancement of Science (AAAS), has called it? Or has the National Academy of Sciences (NAS) gone "hat in hand" to negotiate an "about-face from the moral stance of 1980," when such exchanges were partially cut off to protest Soviet persecution of refusenik scientists? The latter charge was made last spring by three Nobel laureates—Paul Flory of Stanford University, Christian B. Anfinsen of Johns Hopkins University, and Arno A. Penzias of Bell Telephone Laboratories.

Then there is the vexing question of how "free" academic researchers should really be in choosing which projects to work on. Many campuses ban classified (that is, secret) research for the government. Some faculty members are pressing their universities to go even further and declare certain research off limits because they consider it morally repugnant.

In short, not even academic scientists appear to want totally unrestricted freedom to choose research projects. But there is not yet a consensus as to where the limits should be. This muddies the ongoing discussion of what controls, if any, should be placed on the free exchange of "sensitive" (militarily useful) but nonsecret knowledge in the interests of national security.

The four-year extension of the Export Administration Act—the subject of Senate debate in early summer—specifically states that it is U.S. policy to encourage free scholarly communication. The importance of such freedom was emphasized by all participants in a roundtable discussion of science and secrecy held in Washington by the AAAS, the Association of American Universities, and the Scientists' Institute for Public Information.



How absolute is the freedom to carry out and publish academic research?

Yet when it came down to specific issues, there were reservations. Assistant Secretary of Defense Richard Perle said he had serious misgivings about U.S.-Soviet scientific exchanges because the Soviet visitors often had hidden agendas as spies or propagandists. While that may be so, Stanford University President Donald Kennedy conceded, exchanges are a "public good" that the scientific community—and hence the country—really needs.

Nevertheless, when pressed, Kennedy admitted that many U.S. scientists have a double standard. Academics who would resent being cut off from contact with Soviet colleagues in the name of national security would turn their backs on those same colleagues to protest the treatment of Andrei Sakharov.

The ambivalence within the U.S. scientific community concerning secret work on campus also surfaced when Perle asked Kennedy to justify his university's ban on such research: "Will Stanford prohibit a researcher who wants to from doing classified research? And how do you square that with academic freedom?" Kennedy observed that "our scientists think the kind of science they do requires free exchange."

Since that discussion, Stanford's Committee on Research has reaffirmed the university's ban on secret work. It has also refused to institute a ban on so-called "abhorrent" research, such as development of poison gases or other means of mass extermination. As chairman David Korn explained during the recent AAAS annual meeting, a majority of the committee believes that moral judgments on the acceptability of research "tend to reflect an individual's satisfaction with social, political, and ethical values, or with government policies, which change with time and circumstances."

Nevertheless, this remains a live issue on many campuses. In fact, Gordon Kane of the University of Michigan told the AAAS that his university has formally banned classified research when its "clearly foreseeable end is to destroy human life or incapacitate humans." But university regents refused to extend the ban to unclassified work, which comprises by far the bulk of Michigan's research, because they fear that such a policy is open to abuse. Korn, a professor of physics, said he is concerned that antiabortionists might use such language to try to restrict research on diagnosing defective embryos.

Stanford committee members may have shown more wisdom when, in trying to calibrate a moral meter stick, they found "we couldn't put it into words." As Korn points out, such a general restriction invites trouble. Opponents of genetic engineering already claim that such tinkering raises serious and poorly understood public dangers. Many academics oppose research on the heritability of human intelligence, considering the subject socially divisive. A general ban on morally repugnant research might be used to halt or restrict genetic or even brain research.

Thus, while concern over academic freedom has largely focused on export controls and publishing restrictions, other dangers arise from within the research community itself. That community is being challenged to define clearly what it means by academic freedom and to decide just how much freedom it really wants. □

ROBERT C. COWEN IS SCIENCE EDITOR OF THE CHRISTIAN SCIENCE MONITOR *AND FORMER PRESIDENT OF THE NATIONAL ASSOCIATION OF SCIENCE WRITERS.*

ILLUSTRATION: JON MCINTOSH

SCIENCE/SCOPE

A new technique may expand the use of lasers in commercial and military applications. The approach, called optical phase conjugation, is considered a major advance in optics because it offers a solution to distortion problems that have limited the use of lasers. When a laser beam passes through a turbulent atmosphere or a severely strained optical component, the beam is distorted and the information it carries is degraded. Hughes Aircraft Company's technique, however, forces the laser to retrace its path through the distorting medium so the beam emerges free of distortion. The method eliminates the need for complex electro-optical and mechanical components to correct the distortions.

A future generation of infrared "eyes" for space surveillance systems will be far more capable as the result of technology advances at Hughes. These systems will be able to see distant targets in space, in the air, or on the ground—and relay data instantly to ground stations. Advances are being made in focal plane design, signal processing architecture, and in the design of a unique sensor with very steady telescoping optics. By building modularity and programmability into the new technologies, researchers are making it possible for systems to use tailored combinations from a single family of hardware and software. For its advances, Hughes received an Award for Technical Achievement from the Strategic Technology Office of the Defense Advanced Research Projects Agency. This effort was sponsored by DARPA and monitored by the U.S. Air Force Space Technology Center.

A laser that won't cause blindness or other eye injuries will be used in a rangefinder now under development by Hughes for the U.S. Army. The lightweight device, designated the AN/PVS-6 Mini Eyesafe Laser Infrared Observation Set (MELIOS), resembles a binocular case. Its neodymium yttrium aluminum garnet laser beam is sent through a chamber, or cell, filled with high-pressure methane gas. There the 1.06-micron wavelength is transformed into a wavelength of 1.54 microns. The new signal is safe because it never reaches the retina, but instead is absorbed in the vitreous humor, the white area of the eye between the retina and the lens. MELIOS is being developed under a competitive contract from the U.S. Army Night Vision and Electro-Optics Laboratory.

Large ceramic circuit boards will be built into the Amraam missile to help keep the missile reliable, lightweight, and low in cost. These boards, measuring 5x7 inches, are used instead of standard printed wiring boards where many components must be crammed into a small space and where a lot of heat must be dissipated. The cost of these circuit boards has been lowered significantly by replacing gold circuits with copper. The boards are manufactured by a thick film process in which layers of copper and glass dielectric are alternately applied to provide a multilayer circuit board. Hughes designed and developed the advanced medium-range air-to-air missile for the U.S. Air Force and Navy. The manufacturing facility is located in Tucson, Arizona.

Excellence in communications systems engineering has placed Hughes in a leading position in many of the major U.S. Air Force, Army, Navy, and Marine Corps communications programs, including PLRS, PJH, MILSTAR, and JTIDS. Our Communications Systems Division is committed to meeting the strategic and tactical communications requirements of the 1990s and beyond. We have a continuing need for qualified engineers in all communications systems disciplines at all levels. If your career goals include design of advanced antijam communications systems or HF through millimeter-wave radios, please send your resume to Hughes Ground Systems Group, Professional Employment, P.O. Box 4275, Dept. S2, Fullerton, CA 92634. Equal opportunity employer. U.S. citizenship required.

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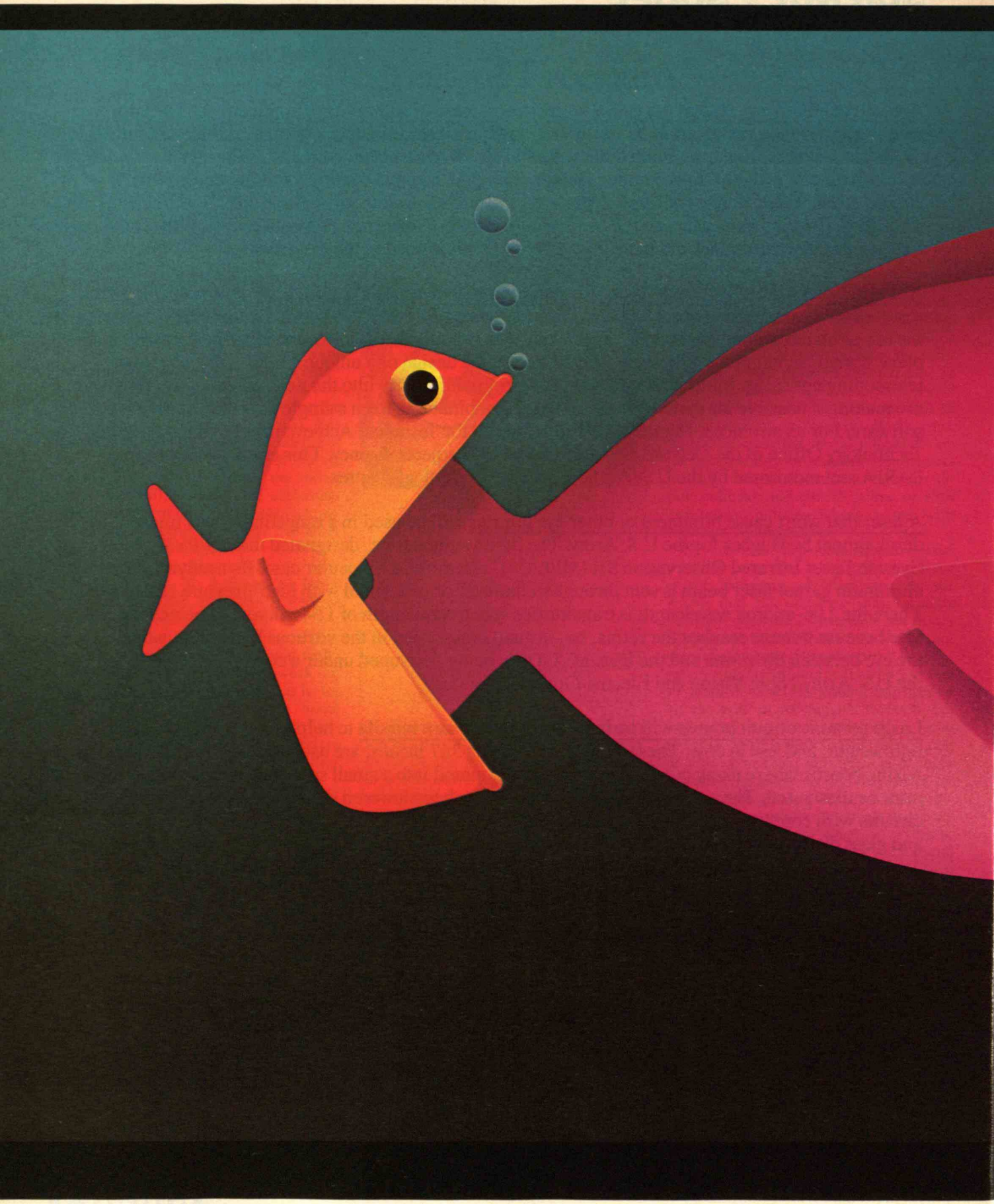

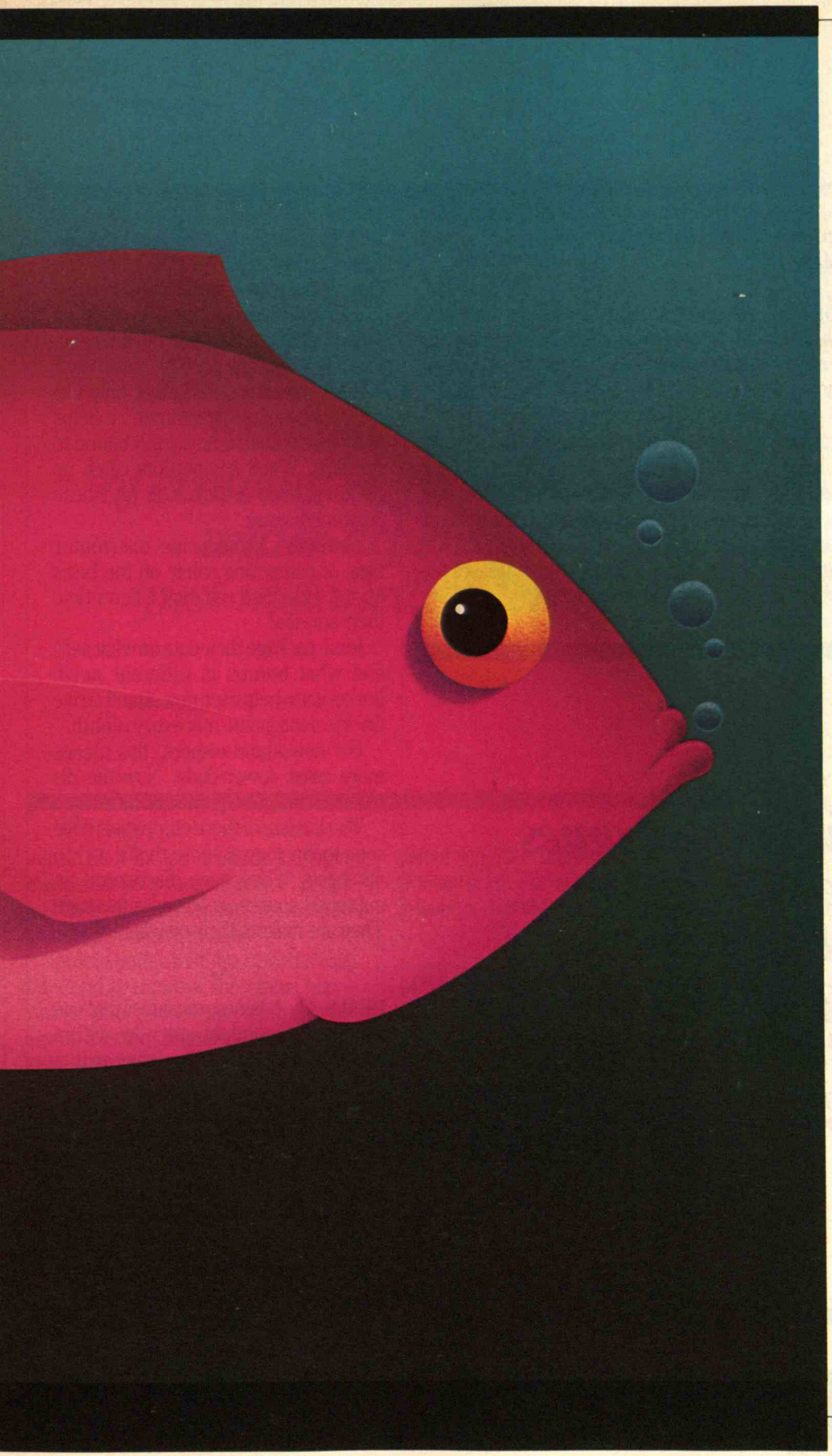

HOW THE COMPETITION IS PLANNING TO STEAL YOUR CUSTOMERS

At first, the new office automation system was a big hit. It paid for itself in the first 18 months.

But today the faces around the boardroom table are glum.

While this company was investing a fortune to become more efficient, a smaller competitor was spending half as much to make itself more *effective*.

Now the ambitious David is stealing the efficient Goliath's customers.

This year American business will invest $141 billion in computers and communications gear.

The lion's share will go for systems that automate routine office chores,

continued on next page

continued from preceding page

boosting productivity, reducing costs.

But efficiency is only one side of the coin.

Admits one manager: "Most of us are too busy counting the beans on our desks to think about how these new systems might *change the way we compete.*"

The problem is that it's a lot easier to think about your business as it is, than to imagine your business *as it could be.*

Enter AT&T Information Systems. We earn our pay by helping companies use technology to achieve their objectives – whatever those objectives are.

Below are a few ideas to start your competitive juices flowing.

◇

CATAPULT. Bean counters beware! Right now, a handful of companies are quietly rewriting the business school casebooks by using information systems to gain a strategic advantage.

Even smaller companies have found in these systems the means to deliver added-value services at little cost, and to catapult themselves into new fields of opportunity.

Example: A drug company leases terminals to pharmacies to save ordering costs. Idea: use the same system to process pharmaceutical *insurance* data for druggists – at a 5% commission. Result: more revenue, closer ties with customers, a broader business base.

Example: A brokerage firm installs a system that links 3 ho-hum investments into a splashy new service.

The resulting synergy not only captures a host of new customers, it helps keep them. Each is now *triply* bound to the firm. When competitors catch up, they will need crowbars to pry these customers away.

Example: A magazine distributor tires of competing solely on the basis of *cost.* How else can they differentiate their service?

Idea: package their data on what sells and what bombs in different neighborhoods to help each newsstand strike the ideal magazine mix every month.

For newsstand owners, this means more sales, fewer duds. Now the distributor charges a premium.

The leaders of these companies have seen technology as more than a way to cut costs. They have discovered an untapped source of business leverage. They are making their own lightning.

◇

DEALS. The business machines that can work such wonders are now within reach of virtually any company with a working checkbook. So how is it that *every* ambitious company hasn't installed a few whizbangs and made business lightning strike?

Answer: technology is only as good as the goals you set for it.

At AT&T it is gospel that *business strategy dictates system design.* (It is no accident that 2,800 of our Account Executives are specialists in particular

> ***A handful of companies are rewriting the business school casebooks by using information systems to gain a strategic advantage.***

> ***Business imperatives have a nasty way of evolving right out from under expensive, just-installed systems.***

industries.) In our opinion, too many companies keep their "Systems" people and their "Business" people in separate, watertight compartments.

Little wonder that the systems they buy tend to improve the status quo – rather than propel the company forward. It is the difference between buying a system to process your salespeople's expense reports ... vs. one that helps them close more deals.

Free offer: Not every manager has a corps of information specialists on tap. How, then, do you gauge the competitive opportunities today's technology holds for your company?

Recently, we ran across an article in the *Harvard Business Review* that can help you see your choices clearly – before you call in the vendors. It is objective and brief. For a free reprint, please telephone 1-800-247-1212.

◇

ADVERTISEMENT. Business leaders often complain that the high priests of technology are too gung-ho for *change*, that new systems become old systems too fast.

Just as often, it is the company itself that has changed. Business imperatives have a nasty way of evolving right out from under an expensive, just-installed system.

Enter AT&T. Recent changes in the way our company competes have spurred us to devise a new approach to office automation. Result: a "systems architecture" that makes change work *for* business – instead of against.

The briefing books on AT&T's new Information Systems Architecture are heavy going for non-technical types. Most ask for the capsule version.

Here it is.

Instead of pinning our hopes on a particular kind of business machine, AT&T is creating a set of high-tech "building blocks." *A system of systems* in which office machines are virtually interchangeable. And in which old hardware can easily learn new "tricks" as business needs change.

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SAMUEL C. FLORMAN

Up and Down the Dual Ladder

SHOULD engineers become managers? The question invariably evokes feelings of ambivalence.

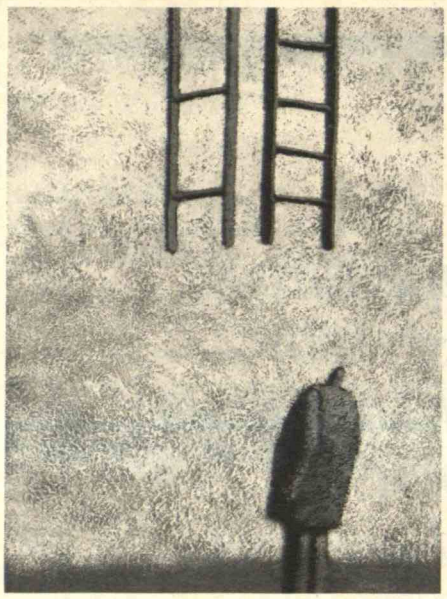
According to one tradition, management is an integral part of technological creativity. For the fabled "chief engineers" of pyramids, cathedrals, bridges, and railways, design and construction were joined in a single organic process. During the early days of corporate industrialism, whether the product was a steel ingot, a steam engine, or an electric transformer, conception and execution went hand in hand. The belief that factory organization—including worker efficiency and motivation—were accessible to technical analysis gave rise to scientific management and industrial engineering. The author of a landmark 1929 report on engineering education noted with satisfaction that two-thirds of all American engineers were embarked on "a healthy progression through technical work toward the responsibilities of management."

On the other hand, as engineering has become more specialized, and as business management has evolved as an independent discipline with its own schools and trappings, many engineers have recoiled from the managerial role and have sought to maintain "professional integrity" in technical design. The characteristics of a good manager—a feeling for people, politics, and the bottom line—appear to conflict with those of a first-rate creative engineer—an aptitude for numbers, theorems, materials, and spatial relationships.

One could react by maintaining that each person should find the niche to which he or she is drawn by particular talents and interests. But difficulties arise because managers earn more money, power, and prestige than purely technical colleagues.

This problem is resolved for the engineers who move willingly into management as they get older. But among those who wish to stay with technical work, the inevitable result is a festering resentment. They see rewards going to people whom they believe to be less talented and to be making lesser contributions. Not only do the ill feelings among technical personnel create morale problems; organizations sometimes lose pure engineering talent when creative people pursue higher salaries and recognition in management.

SAMUEL C. FLORMAN, A CIVIL ENGINEER, IS AUTHOR OF ENGINEERING AND THE LIBERAL ARTS, THE EXISTENTIAL PLEASURES OF ENGINEERING, *AND* BLAMING TECHNOLOGY.



The tangible and intangible rewards for managers and engineers will inevitably be unequal.

A proposed solution to this problem, adopted by some corporations after World War II, is the so-called "dual ladder." This system allows engineers to climb to the highest organizational levels by doing technical work, keeping pace with managers in a carefully planned schedule of promotions. However, according to a panel studying engineering employment for the National Research Council, this concept "has not generally fulfilled its initial promise." It works well only in large organizations and for limited numbers of engineers. William Sackett, a vice-president of Honeywell's Corporate Technology Center, noted that in many organizations "the dual ladder comes and goes," tending to "flounder from an imbalance of power . . . The real power is in management."

It is apparent that any attempt to correlate income and prestige with "worthiness" is doomed to fail. The marketplace imposes a certain rough and ready democracy, but its workings do not correspond with the personal values of most citizens. It is no secret that teachers, judges, and nurses are underpaid while basketball players, lawyers who prosecute negligence suits, and stockbrokers receive more than they "deserve." Nor is unfairness limited to our own relatively free-wheeling society. In other lands, wealth and perquisites tend to gravitate toward commissars, generals, and black marketeers. Karl Marx wrote, "From each according to his abilities, to each according to his needs," but that phrase does not describe a workable system. We look in vain for a utopia in which the distribution of tangible rewards is totally just. It is against this broad panorama that the problems of the technically creative engineer must be viewed.

Pleasures of Technical Creativity

In our society we pursue concepts of fairness in social programs and tax legislation. But we are reluctant to tamper too much with the free-market system that seems to serve us well in spite of inequities. Also, some people choose not to compete for wealth and fame, instead pursuing other values, motivated by other incentives. For engineers, the pleasures of technical creativity are inherently rewarding. As a civil engineer in the construction industry, I have been a manager almost since the day I graduated from engineering school. I have had my share of compensations, but when I and those like me meet with engineers who are engaged in design, we cannot help but feel traces of envy. Clearly, *designers have more fun.*

On occasion, technically creative engineers get it all—wealth and fame along with the satisfactions of invention. The tycoons of Silicon Valley are an example. For most engineers, however, the move from scientific craft to engineering management must be viewed as a natural process, like aging, that has its rewards as well as its drawbacks.

There will always be those who resist such a course, and I consider this a plus for society, the profession, and the human spirit. Still, I cannot see how these people can be satisfied in every respect. The dual ladder is a concept, imperfect at best, not a constitutional right. Happily, as Emerson said, "The reward of a thing well done is to have done it." □

ILLUSTRATION: ROB COLVIN

Don't miss
"Quest for the Killers"
a PBS special series starting Monday, September 9.
See local listings for further information

Silent partners in world health

Recent triumphs in the field of tropical medicine will soon be celebrated in "Quest for the Killers," a documentary series to be aired nationally on PBS. One program will describe the fight against a worm infestation called schistosomiasis on the island of St. Lucia in the Caribbean.

Schistosomiasis affects as many as 200 million people in Africa, Asia, the Middle East, Puerto Rico and Latin America. It is often called "snail fever" because at one stage of their life cycle, *Schistosoma* worms infect snails that live on the bottom of rivers and streams. These parasites invade the skin of humans who drink, wash or swim in contaminated waters. They can cause severe itching, fever, diarrhea, and eventually irreversible damage to the liver. For 16 years, researchers visiting St. Lucia have been testing the practicality of various methods of control. Three approaches have proven to be most effective.

First, a public health team sprayed the rivers and streams of St. Lucia to get rid of infested snails. New plumbing facilities were constructed to assure a supply of uncontaminated water. Finally, treatment of people carrying the parasite was greatly facilitated by a drug developed and supplied by Pfizer. While previous treatments had to be given by injection, this drug was given orally only once, making it much simpler to reach a large number of people. The total control and elimination of the parasite is not yet a reality, but this combined medical and environmental program has done much to make life better for the people of the island.

Developing a drug such as this is a significant task that takes a decade or more and tens of millions of dollars. It generally involves the synthesis of hundreds of compounds in the organic chemistry laboratory. These compounds are then screened for antiparasitic activity. If one or more of them shows promise, the next step is to do toxicity studies and learn all about how the potential new drugs behave in laboratory animals. Only after completion of extensive, time-consuming animal studies can the drug be tested for safety and effectiveness in humans. And clinical trials in human patients can last for several years.

If the clinical trials indicate that the drug should be made available, new technology must be developed to produce it on a mass basis, and in cases like this, with little if any profitability for the developer.

Drug research and development isn't always "good theater." And it's largely a team endeavor generally without charismatic heroes. The days of Paul Ehrlich and his "magic bullet" are long past. The work of the pharmaceutical industry isn't usually the stuff of TV documentaries. But the drugs depicted in the various episodes came from the laboratories of pharmaceutical companies all over the world. The pharmaceutical industry has been the silent partner of government agencies, physicians, nurses and their associates who achieved public health miracles in St. Lucia and other developing countries.

In the Third World, pharmaceuticals are perhaps even more important than in advanced industrial countries. Often they are the only form of advanced medical technology which is practicable. Other forms of care, such as surgery, are often too cumbersome and too demanding of scarce resources. Drugs, by comparison, are portable, relatively inexpensive and comparatively simple to use.

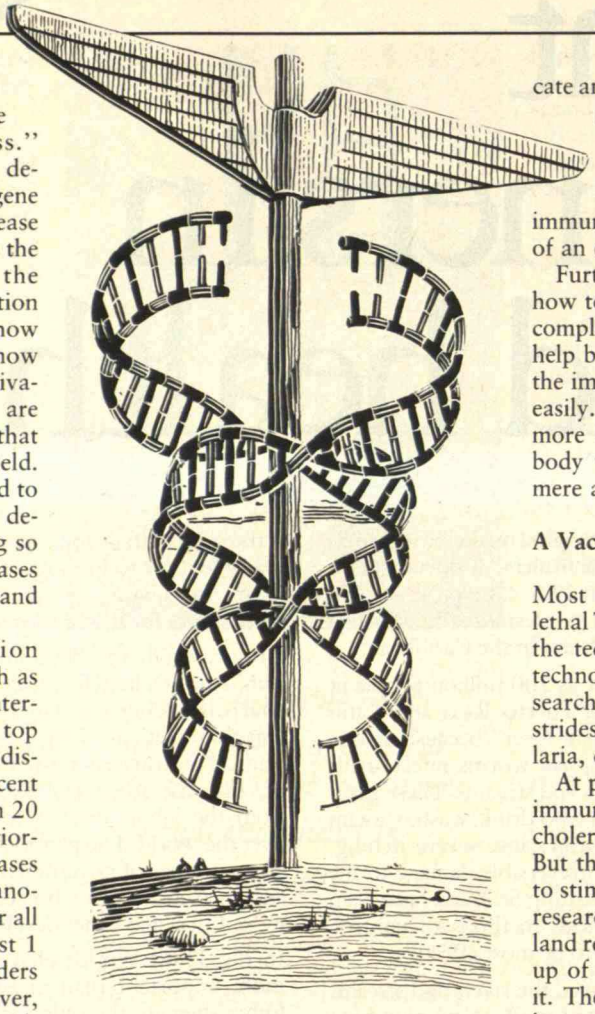
The vast majority of drugs for the Third World and also for developed countries originate in the pharmaceutical industry. The government agencies do not have the broad expertise or resources for drug development, and medical schools and universities have different missions. Only the major research/pharmaceutical companies have the necessary skills and resources. Most manufacturers of generic drugs lack the research capabilities to create new drugs and test them for safety and efficacy. And that's only one reason an economically viable research-based pharmaceutical industry is important to all of us.

Pfizer is pleased to have been a partner in helping to reduce the hazards of one of the world's more widespread health problems. Pfizer is also pleased to have had an opportunity to help make it possible to tell this story. Therefore, we hope you will find time to watch "Quest for the Killers."

Pfizer PHARMACEUTICALS • A PARTNER IN HEALTHCARE

BY MARC LAPPÉ

Biotechnology's Debt to Public Health



BIOTECHNOLOGY has come of age. It is, in the jargon of the stock market, "big business." However, caught up as we are in the debate over human genetic engineering, gene transfers between species, and the release of genetically modified organisms into the environment, we may be missing the broader results of this commercialization of recombinant DNA. Decisions about how to exploit the new technology are now being driven by purely economic motivations. Most biotechnology companies are focusing only on medical products that promise a high short-term financial yield. They are developing therapies designed to alleviate the disorders of the wealthy, developed countries. And they are doing so at the expense of efforts to cure diseases that are causing widespread illness and death in the Third World.

The World Health Organization (WHO) recently targeted diseases such as bacteria- and amoeba-produced dysenteries, cholera, and typhoid fever as the top priority of public-health efforts. These diseases alone are responsible for 80 percent of all illness worldwide and more than 20 million deaths annually. In a second-priority group, WHO named parasitic diseases such as leishmaniasis, malaria, trypanosomiasis, and river blindness. Together all these diseases chronically afflict almost 1 billion people. A group of rarer disorders including rabies, leprosy, dengue fever, and Japanese encephalitis are also considered high priorities for control, as they appear to be on the upswing around the world.

Collectively, these diseases present major challenges to public-health efforts for the remainder of the century. Unlike the scourges of an earlier era—smallpox, measles, polio, rheumatic fever, and pneumonia—major infectious and parasitic diseases cannot be completely eliminated by traditional immunization techniques or controlled with antibiotics. The smallpox virus, for instance, was not particularly resistant to vaccines. But many parasites are adept at changing their genetic stripes to thwart the efforts of the body's immune system to locate and destroy them. Since neither antibiotics nor conventional vaccines are powerful enough to kill these hardy organisms on their own, the success of treatment depends very much on an individual's innate resistance and state of health. The fact that vast numbers of people now living in the Third World are undernourished and unhealthy makes it all the more difficult to control parasitic diseases.

Now recombinant-DNA technology offers enormous potential for reducing their prevalence through the development of effective vaccines. More important, recombinant-DNA techniques may offer the *only* means for developing such vaccines. With these techniques, scientists can isolate and manipulate the genes that produce antigens, the proteins that signal the presence of a foreign substance—be it virus, bacterium, or parasite. The body's immune system responds to the presence of these antigens by producing antibodies that locate and "bind" to the foreign agents. This antibody-antigen binding is recognized and destroyed by other parts of the immune system. Since the antigens provoke this immune response, they can form the core of an effective vaccine.

Furthermore, researchers have learned how to mix the antigen with adjuvants—complexes of oils and dead cells—that help bind and present the antigen so that the immune system can recognize it more easily. The result is a much stronger and more lasting immune response than the body would normally provide against a mere antigen.

A Vaccine for Cholera

Most of the vaccines needed to combat lethal Third World diseases are well within the technological capabilities of the biotechnology industry. University-based researchers have already made significant strides in developing vaccines against malaria, cholera, and typhoid fever.

At present, those at risk for cholera are immunized with heat-killed strains of the cholera-causing organism *Vibrio cholerae*. But the deadened strain is usually unable to stimulate a lasting immune response. A research group at the University of Maryland recently engineered the genetic makeup of *V. cholerae* to weaken but not kill it. The result is a nontoxic strain of the bacterium that could confer lasting immunity as a vaccine.

Researchers at the Swiss Serum and Vaccine Institute in Berne have developed a similar vaccine from the bacterium that causes typhoid fever. But they have gone one step further in producing a "self-destructing" strain that provokes an immune response and then dies after undergoing only four or five cell divisions in the patient's body.

Unfortunately, commercial development has not followed these technological breakthroughs. According to a survey by the Smithsonian Science Information Exchange in 1982, only about 1 percent of all federally funded research projects in the United States (16 out of 1,529) dealt with vaccine development. Of all the potential targets for human recombinant-DNA vaccines, only hepatitis B vaccine appears likely to be on the market by 1986.

Why should our nascent biotechnology industry be held to a higher standard than

MARC LAPPÉ is adjunct associate professor of health policy at the School of Public Health, University of California at Berkeley. He is the author of Broken Code: The Exploitation of DNA: *(Sierra Club, 1985).*

ILLUSTRATION: CHRISTOPHER BING

the pharmaceutical industry or any other profit-making business? After all, only about 3 percent of the R&D efforts of U.S. pharmaceutical companies is directed toward diseases of the developing world. And many U.S. pharmaceutical companies have dropped out of the vaccine business entirely because of the increased costs of lawsuits and liability insurance.

The new biotechnology firms are caught up in an even fiercer battle to survive. Nevertheless, I believe they should be held more accountable than the major pharmaceutical corporations. There are a number of reasons why. First is the power inherent in recombinant-DNA technology. At its ultimate, the technology could be used to change the very course of evolution. At present, biotechnologists—like their counterparts in the early nuclear industry—have tremendous capacity to use their techniques for good or evil.

Second, almost all the research on molecular biology from which the industry is gleaning its future profit-making products was funded by public sources. Since American taxpayers footed the initial cost of such research, they should have some say in how its fruits are used. Furthermore, many of the molecular biologists who developed the original recombinant-DNA techniques effectively argued for retaining the unregulated status of the industry based on its potential to provide enormous benefits to humanity. Scientists such as Herbert Boyer of the University of California at San Francisco, Maxine Singer of the National Institutes of Health, and Paul Berg of Stanford promised great social benefits from an unfettered industry. Yet most biotechnology companies, Boyer's Genentech included, have opted for short-range projects with high rates of return. Should we not hold these scientists to their word?

Quick Fixes of Limited Benefit

Finally, and perhaps most important, humanitarian considerations argue for a different choice. Consider that malaria strikes more than 200 million people worldwide. And with the spread of resistance to traditional antimalarial drugs and the resurgence of the *Anopheles* mosquito (the principal carrier of the malaria parasite), malaria will probably become an even greater menace to public health.

Contrast that situation with the one surrounding hemophilia, a blood-clotting disorder that strikes 1 in 10,000 U.S. males. The disorder is caused by deficiencies in the factors, or proteins, that enable the clotting of blood so essential to the healing of a wound. Hemophiliacs are in danger of bleeding to death because of this protein deficiency.

In principle, hemophilia can be treated by administering donated blood replacements that contain all the factors needed to clot blood. But this therapy is expensive—costing from $5,000 to $7,000 a year per patient—because it means the difference between life and death. The treatment is also perceived to be somewhat dangerous because the donated blood may be contaminated with hepatitis virus or the AIDS virus.

At least three biotechnology firms have undertaken a crash program to genetically engineer and market the blood-clotting factors. In 1984, Genentech became the first company to successfully clone and produce Factor VIII, the most common deficiency in hemophiliacs. Given the demand, this blood substitute will also be marketed at an extraordinarily inflated value.

The situation is similar for enzymes genetically designed to dissolve the blood clots that are a major cause of stroke and heart attacks. Biotech companies have developed such enzymes as high-priority products with financial backing from major pharmaceutical companies. However, the enzymes' effectiveness is limited to the first two hours after a heart attack. Thus, only those patients who have access to prompt and highly sophisticated medical care can benefit from their use. Some would argue that the the nation's health dollars would be better spent on developing preventive approaches to heart disease than on "quick fixes" of such limited utility.

Unfortunately, a successful preventive program—whether it be vaccine development or an antismoking campaign—inevitably shrinks the demand for treatment products. And companies choose new products based on the bottom line, not on public-health needs.

Given the commercial reality, what can we do to encourage biotechnology companies to develop and market products for humanitarian purposes? To begin with,

Continued on page 78

Particle Wars, and Saving Public Lands

Particle Wars

The Particle Connection
by Christine Sutton
Simon and Schuster, $16.95

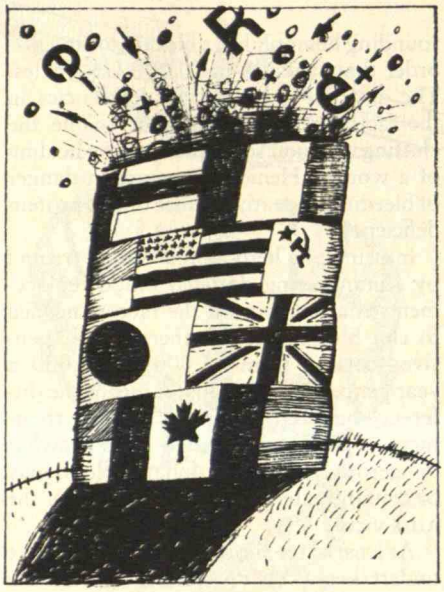
Reviewed by Michael Riordan

Once upon a time, U.S. particle physics knew no equal in the world. From the 1950s through the 1970s, the most important discoveries in the field were made at our own atom smashers, and only later confirmed by scientists in Europe and the Soviet Union. A well-worn path led to Stockholm from American universities, trodden by such Nobel Prize-winning experimenters as Chicago's James Cronin, Berkeley's Luis Alvarez, Princeton's Val Fitch, Stanford's Robert Hofstadter and Burton Richter, and M.I.T.'s Samuel Ting.

But U.S. dominance of particle physics ended in the early 1980s, after powerful new accelerators came on line in Hamburg and Geneva and opened up virgin territories for European scientists to explore. By 1983, when the discovery of the long-sought W and Z particles at Geneva verified beyond any doubt the unity of the electromagnetic and weak nuclear forces, Europe was clearly ahead. Last year's Nobel Prize for Physics, awarded to Italy's Carlo Rubbia and Simon van der Meer of the Netherlands for their crucial contributions to this discovery, merely underscored the obvious.

In *The Particle Connection*, Christine Sutton chronicles the experiments that uncovered the W and Z particles and put the United States into the backseat of high-energy physics. As a former member of the international team that eventually made the discovery, and more recently a contributing editor of Britain's *New Scientist*, she brings excellent credentials to her task.

Sutton does an admirable job of explaining the decades-long theoretical evolution leading to the recent W and Z discoveries. That is an important prerequisite if her readers are ever to understand why physicists are so excited by these events. Displaying a rare flare for the apt metaphor, Sutton explains such esoteric concepts as the "gauge theories" and "electroweak forces" that are the everyday fare of theorists working at the modern frontiers of particle physics. This is a time much like the end of the nineteenth century, when Hertz's discovery of radio waves (later identified as "photons," the particles of electromagnetic radiation) verified Maxwell's unification of electric and magnetic forces. Like their earlier counterparts, theoretical physicists now think they can calculate the answers to everything—given enough computer time.



But when it comes to telling the experimenter's side of the tale, Sutton largely misses the point. It was not merely a single experiment but rather a complex chain of many small but important developments that finally established the existence of the W and Z. By the time the famous particles were "discovered" at the CERN proton-antiproton collider in Geneva, their existence was essentially a foregone conclusion. Experiments of the previous decade had established their properties so well that physicists knew exactly where to look. The greatest surprise would have come if they had *not* found these particles right where they were expected.

The "discovery" was more a triumph of the accelerator builders than of anyone else. Producing the extremely massive W and Z particles—each almost 100 times heavier than a proton—normally would have required a tremendous machine backed by massive government funding. But the team of physicists led by Rubbia and van der Meer found a relatively cheap way to generate the necessary high energies by colliding beams of protons and antiprotons in an existing CERN accelerator. Convincing scientists that it could be done, and focusing the energies of a huge international collaboration on this single task, were the real contributions of Rubbia—and the main reasons he received the Nobel Prize.

Yet the politics of such an enormous task—of bringing the intellectual and financial resources of a scientific community to bear upon this one quest—are completely absent from the book. Given her close association with the collaboration, Sutton would have been the ideal person to have written such an account. Why, for example, did the experiments occur at CERN and not at the equally suitable U.S. machine at Fermilab? Sutton never even raises such an obvious question.

Such an in-depth analysis would have provided a welcome perspective from which to evaluate current U.S. plans to regain our lost lead in this field. A major reason we fell behind is financial: new accelerators were delayed or cut back in scope because the high-energy physics budget, among others, had to be slashed during the 1970s to help pay the overwhelming costs of the Vietnam War. Unburdened by such concerns, Western European nations have made regular contributions to CERN, permitting a steady expansion of its accelerator program.

Stung by their new second-class status, U.S. physicists are racing to catch up with Europe. On the drawing boards now are designs for the Superconducting Super Collider, or SSC, a tremendous atom smasher that in one guise is large enough to encircle the entire District of Columbia—suburbs, Beltway, and all. The colossus would cost some $3 billion to $5 billion just to build and equip, doubling the annual U.S. outlays for high-energy physics.

These are the kinds of sums usually reserved for military procurements. That a government facing hundred-billion-dollar deficits can even begin to contemplate such a vast commitment to a single giant piece of scientific equipment with no immediate practical benefits is baffling. But $40 million has already been spent or budgeted just for feasibility and design studies.

Presidential science advisor George A. Keyworth II has championed the idea of building an SSC almost from its inception. It is difficult to avoid the suspicion that at least some of his enthusiasm stems from the possibility of eventually using its various technologies in the Star Wars program—or Strategic Defense Initiative—he so eagerly touts. After all, particle-beam weaponry now being developed at Liver-

ILLUSTRATIONS: EUGENE YELCHIN

Some experts would have us rethink the public-lands strategy from top to bottom.

more is based on the technology of linear electron accelerators pioneered decades ago at Stanford. Who can guarantee that similar borrowings from today's accelerator physics will not occur in future decades? It would be a truly curious irony if the same particle physicists who stand in the forefront of opposition to Star Wars were to unwittingly contribute to some of its crucial technological components.

There can be no absolute guarantees that such an outcome will not occur, but the open dissemination of everything learned from an SSC would certainly help. The participation of other nations in such an imaginative but expensive scientific project would also help lessen fears while diminishing the strains on the overall U.S. research budget. A single nation can no longer afford to build the most advanced accelerators needed to push back the frontiers of particle physics. Here we have everything to learn from the fine example set by European physicists at CERN. International cooperation can bring out the best that the scientific enterprise has to offer humanity—and act as a safeguard against the worst. It is high time such activity began to occur on our own soil. □

Physicist MICHAEL RIORDAN is writing The Hunting of the Quark, *a history of particle physics (Simon & Schuster).*

Whose Woods These Are

This Land Is Your Land
by Bernard Shanks
Sierra Club Books, $19.95

Reviewed by Charles E. Little

If you are an American citizen, you are part owner of 740 million acres of evergreen forests, deep lakes and fast-moving rivers, open rangelands, and craggy mountain wildernesses. These sublime landscapes—a third of the nation, mostly in the West—are the envy of the world and contain a trillion dollars worth of natural resources that could provide wealth for generations to come.

Should you wish to tour your property—which is your right, after all—what might you find? Not beauty, solitude, and inspiration, says Bernard Shanks, author of *This Land Is Your Land*, and not thoughtful conservation of their resources

for future generations. Instead there is destruction, degradation, and despoliation.

Shanks is right. The raid on resources during the first part of this decade has been reckless in the extreme and without precedent. The late, unlamented Sagebrush Rebellion, which called for state governments to take control of public lands and ultimately to sell them to private interests, was an example of how out of hand the whole business got. Shanks says he himself was a victim of the rebellion, driven from a professorship at Utah State's College of Natural Resources for speaking out against the Sagebrushers. His book is specifically occasioned by the misdeeds of one James Watt, the secretary of the interior from 1980 to 1983 whom environmentalists loved to hate. Shanks chronicles these misdeeds in detail, as well as addressing long-term issues concerning the public lands. Yet despite his impressive array of horror stories, Shanks' evidence deepens rather than reduces the dilemma of how best to manage public lands.

Jefferson's democratic ideal of distributing the public lands so that all could have "a little portion" was no longer feasible once settlers crossed the 100th meridian and encountered drylands a hundred years ago. This land could be used only in quite large acreages, and hardly ever for dirt farming. Then came the Taylor Grazing Act, passed in 1936 partly as a conservation measure. By eliminating the possibility of homesteading, it stopped the reckless plowing of the fragile plains soil. Moreover, the law ushered in a time when the public's interests in preserving wilderness, wildlife, and natural beauty were in ascendance. The apotheosis of the concept came with the enactment of the Federal Land Policy and Management Act (FLPMA) during the Carter administration, which created a means for the public to comment on changes in the management of federal lands. It was FLPMA more than anything else that drove miners, ranchers, loggers, and others with an economic stake in the public lands to try to send the pendulum of policy in the other direction.

However, the Taylor Grazing Act did not introduce a new policy for governing the public lands so much as it abandoned an old one. The traditional policy, meant to benefit small farmers, ranchers, and foresters, was based on historic consensus; everyone believed in an individual's right to own land almost as if it were constitutionally decreed. By changing the emphasis from private ownership to government management, the Taylor Act created, in effect, a policy vacuum made to order for business to exploit. Though today policymakers pay pious lip service to conserving resources through individual land ownership, such as of family farms, large corporations are the only ones equipped to make profitable use of the *public* lands.

Because there is no consensus on how to manage public lands, adherents of the trickle-down theory of economics can make a persuasive case that the exploitation of these lands ultimately benefits everyone. Everyone includes, they argue, the black teenager in Detroit who is unable to find a job until the auto factory begins rehiring, which won't happen unless we take some oil out of the public ground to stabilize prices at the pump.

The conservation community has gone to great pains to show that the amount of recoverable energy in national parks is only 3 percent of known U.S. reserves. Yet while that issue may be made temporarily moot by the collapse of oil prices, the argument rages on in other areas between those who would provide corporations a license to "plunder our resources" and those who would lock them up in perpetuity to save "insignificant" fishes and "obscure" wildflowers.

Shanks proposes that the public lands be seen as an American commons, since *Continued on page 79*

BY STEPHEN DAVIES

Managing Downtown Public Spaces

Good management of public spaces can do more to get people downtown to shop and play than large-scale urban design schemes.

PUBLIC spaces—streets, sidewalks, parks, and plazas—are where the quality of life in cities is often measured. Are there interesting things to do at lunchtime? Are there relaxing places to sit in the sun? Can you pick up a sandwich and eat it outside? Are the sidewalks clean and well maintained? Do you feel safe? For 10 years Project for Public Spaces, a nonprofit corporation of designers and social scientists, has posed such questions in cities across the country. We've been trying to determine what people do in downtown public spaces, why they do it, and what they would like to do. We've documented that many simple needs—to sit, feel safe, be entertained—have been neglected too long in many downtowns.

Our ideas of how cities can best provide the kinds of public spaces that people will use have changed over the years. Early on, we focused primarily on finding ways to design spaces better. But we now recognize that management is often more important and can accomplish more, and faster, than any new design scheme. Many cities have discovered the hard way that just creating a new pedestrian mall, for example, is not enough—brick sidewalks and flowering trees cannot in themselves revitalize a downtown. Good design remains crucial, of course, but is only one ingredient of success. Cities should first take a comprehensive look at their downtown areas and consider small-scale management approaches that will yield immediate improvements. They can then undertake major development projects, if necessary, over the longer term.

We also now realize that cities alone cannot improve their downtowns. Many aspects of an improvement program are simply not a municipality's responsibility, and even those that are cannot always get the full attention they deserve because of limited resources. The private sector needs to take a more active role in most cities, becoming more self-reliant and less dependent on the public sector. Businesses must organize creatively to assume increased responsibility for managing downtown public spaces in partnership with the public sector.

Recognizing the need for more information on how the private sector can get involved in managing public spaces, Project for Public Spaces surveyed 200 private-sector downtown organizations in cities of all sizes across the nation. This "search for excellence" led us to identify four management ingredients essential to successful public spaces:

☐ Someone is responsible for making sure that the space works well for the people who use it.
☐ The details of cleaning, repair, safety, and security are taken care of daily.
☐ The public space is exciting, active, and geared to spontaneous socializing.
☐ Someone watches over the public space consistently, making sure that any changes in its design or management are made in response to people's needs or patterns of use, which inevitably change over time.

ILLUSTRATIONS: ELIZABETH SLOTE

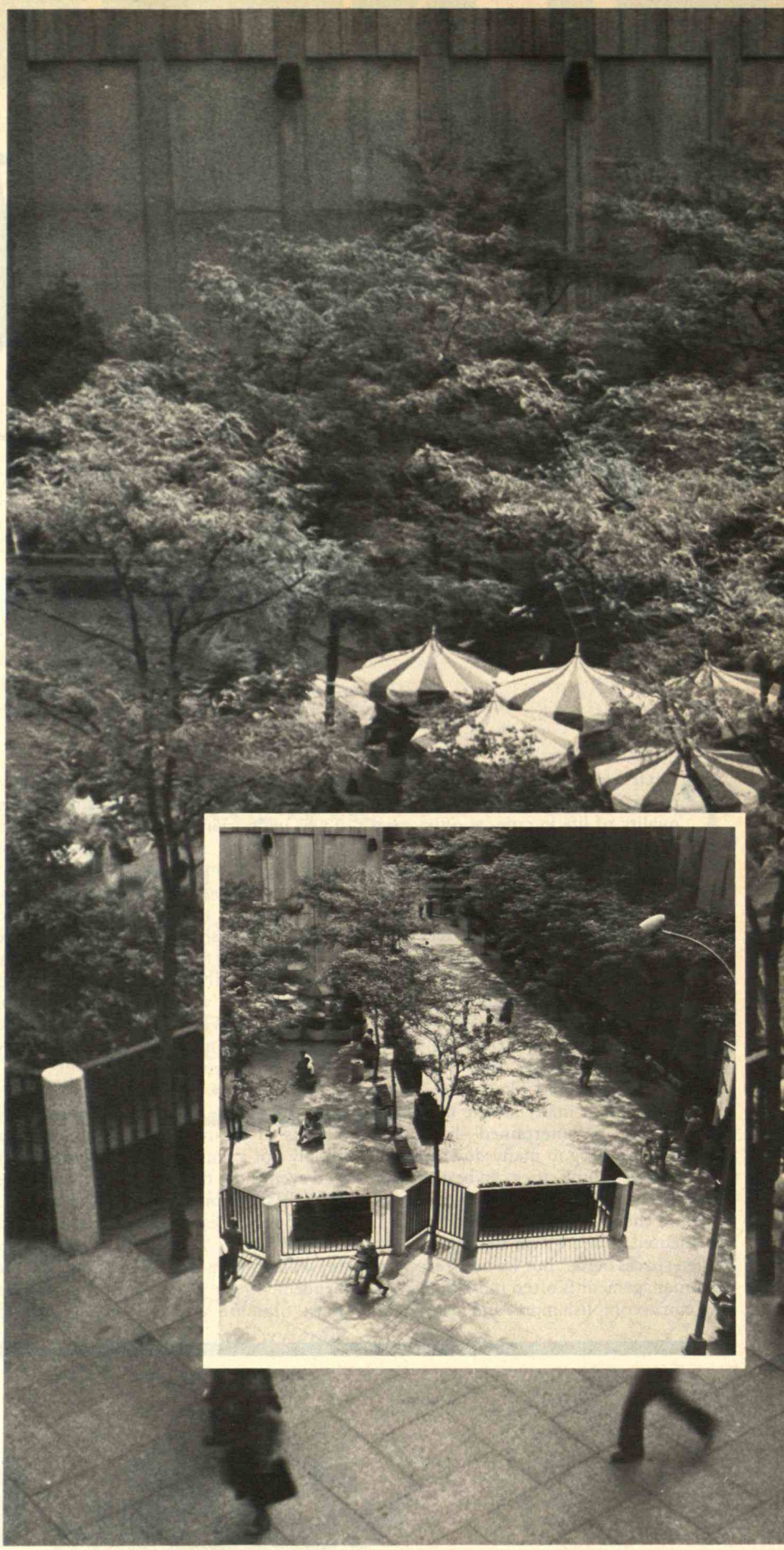
Supplementing City Services

City governments have traditionally provided many services to downtowns, ranging from trash pickup to police enforcement to traffic control. However, these services have declined in recent years as many cities have faced overextended budgets. The changing face of many downtowns over the last 20 years adds to the problem: new types of public spaces have been created for which city governments are unprepared to provide services. Plazas, "vest-pocket" parks, pedestrian malls, transit malls (streets free of vehicles except buses), arcades, widened sidewalks, and the like require more labor-intensive maintenance because they use such materials as brick and wood, and because they contain numerous benches, bus shelters, and other amenities. New designs may also create hidden niches and underused areas that require special attention to ensure their safety. Because of these needs, downtown organizations must step in to supplement the services provided by the city. We have identified three areas in which such organizations can provide services: maintenance, security, and transportation management.

Maintenance. Our surveys of pedestrians and merchants in many downtowns reveal almost universal complaints about the appearance of downtown streets. Of course, people have different standards for the cleanliness of public spaces. For instance, we have found that office workers who spend little time walking around tended to be more critical of the downtown's appearance than the shoppers and other people surveyed on the street. Still, improved maintenance operations *can* produce highly visible and satisfying results. People will notice the difference.

Downtown organizations have responded to maintenance problems with a wide variety of programs and strategies. The programs range from low-cost, almost voluntary efforts to sophisticated, high-budget operations. They tackle such jobs as sweeping, washing, and repairing streets and sidewalks; repairing street furniture; caring for plantings; removing snow; picking up garbage; replacing signs; and general beautification projects that include commissioning wall murals and painting over graffiti.

Portland, Ore., has developed one of the most effective and innovative maintenance programs for its Fifth and Sixth Street



In 1978 Exxon Park in New York's Rockefeller Center was used little (inset), except by drug dealers. Then, visibility from the street was improved; new seating, a cafe, and vendors were brought in; and entertainment was scheduled. Drug dealers vanished and use of the park tripled.

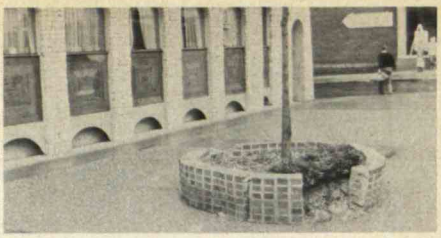
Transit Mall. The city hires two attendants to serve as "resource people" as well as cleaners. These workers become "mayors" of the street, responsible for assuring that it is a comfortable and safe environment for everyone who uses it. The attendants wear special uniforms and have carts with maps and bus schedules. They usually make four circuits a day of the 12-block mall—sweeping and scraping gum off the brick sidewalks, cleaning furniture, sweeping around bus shelters and benches, and even cleaning the mouthpieces of public telephones and polishing the stainless-steel tops of trash receptacles. At the same time they offer a constant security presence on the street and are available to answer questions and give directions. People who use the street tend to know them and seem to like what they are doing.

The attendants are backed up by two privately contracted maintenance crews. One crew cleans and washes the bus shelters daily while the other washes down the brick on the mall every night. There is even a full-time gardener to care for the plants and change the flowers in the numerous planters on the city's sidewalks. The city also repairs broken street fixtures and paving immediately. City representatives believe that this preventive maintenance has also greatly reduced vandalism, since it tends to "breed" in neglected areas.

Security. While downtown security programs must deal with actual crime problems (primarily burglary and shoplifting), people's *perception* of crime and safety is more often the issue. Empty, unlighted areas, the presence of "undesirables," and the lack of people who seem to be "official" help exaggerate the public's fears about the safety of downtowns. Those fears affect people's decisions about where to shop, work, and locate businesses. Unfortunately, many cities have tried to improve security by making their downtowns into fortresses, with buildings oriented toward the interior instead of the street, and with tight control over access. Such designs may indeed prevent burglary and make people feel safe once they are inside. But the buildings are counterproductive in the long run because they discourage activity in the surrounding public spaces, creating staging areas for crime.

Downtown organizations can take an important first step in developing effective security plans by analyzing the design features of buildings and public areas that contribute to problems. For example, a

PHOTOGRAPHS: PROJECT FOR PUBLIC SPACES, INC.



If left unattended, improvements in public spaces can deteriorate rapidly, as did this planter in Poughkeepsie, N.Y. (right).

joint committee of city planners, merchants, and building owners should make a thorough inventory of the unsafe or inactive areas of the downtown district where crimes occur. Solutions may require only minimal changes in design or management, such as trimming a hedge surrounding a park to increase visibility and make the park seem less isolated.

Another, more positive strategy to improve security involves "programming" public spaces. For example, classical or jazz concerts in a downtown park will attract office workers and displace unwanted activities such as loitering and drug dealing. The events can be strategically planned to generate activity in areas that are often vacant, and to generate activity at inactive times of the day—for example, during mid-afternoon, after 5 P.M., and on Saturdays.

Exxon Park in New York City's Rockefeller Center is one of the best examples of successful "activity programming." In 1978, this vest-pocket park went largely unused by local office workers and had become a center for drug dealing. Project for Public Spaces redesigned the park for the building's owners and developed a management plan, adding new seating, a cafe, and vendors. We increased the visibility of the park from the street and instituted regularly scheduled events and entertainment. Today surveys show that use of the park has increased threefold, with more elderly and female users, and drug dealing has been eliminated.

Downtown organizations can also organize information campaigns to educate merchants about crime-prevention techniques, and laypeople about precautions they can take to avoid becoming victims. For example, in Dayton, Ohio, the merchants' association publishes a monthly report detailing neighborhood crimes and what to look out for in terms of suspects, theft techniques, bad checks, and the like. In Fargo, N.D., businesses have established a pyramid phone-calling system to spread word quickly of shoplifters at work downtown.

While such programs help discourage criminals, it often remains necessary to beef up police patrols. In cities that cannot afford to provide more officers, some downtown organizations have directly subsidized the police department, while others have opted to hire off-duty officers or private security guards. Many cities have found that increasing the number of

City representatives in Portland, Ore., believe that their program of continual maintenance not only keeps the Fifth and Sixth Street Transit Mall clean but reduces vandalism, which tends to "breed" in neglected areas. Portland hires crews to tend the plants (middle left). Two attendants are responsible for keeping the mall clean, even polishing the stainless-steel tops of trash receptacles (above). They also provide a security presence on the street and are available to answer questions (top right).

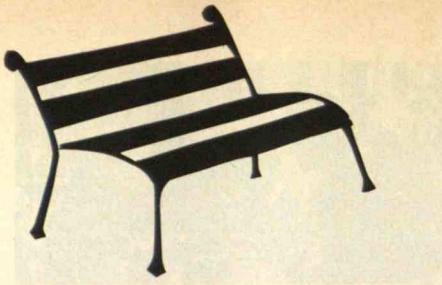
Exaggerated fears about the safety of downtown areas can keep people off the streets and, ironically, aggravate any crime problem that might exist. Thus, security programs must address people's *perception* of an area's safety. Many cities have found that increasing the number of officers on foot patrol works best. Other cities such as Rochester, N.Y. (left), have put officers on horseback, where they are highly visible but in a friendly way.

officers on foot patrol works best; they contribute greatly to people's perception of safety. In a controlled experiment in Newark, N.J., for example, the Police Foundation found that residents of areas where the police switched from car patrol to foot patrol felt more secure than residents of other areas. They also developed a better opinion of the police, and officers walking beats had higher morale, greater job satisfaction, and a more favorable attitude toward citizens.

Mounted police patrols are also becoming popular in cities such as Miami, New York, Atlanta, Providence, R.I., Rochester, N.Y., and Wilmington, Del. Officers on horseback are extremely visible, but in a friendly sort of way. People are always coming up to pat the horse, talk with the officer, and take pictures. From their elevated vantage point, the officers can better spot criminal actions—and few criminals can outrun horses.

Maintaining mounted police patrols needn't be prohibitively expensive. In Atlanta, for example, 15 horses cover all downtown streets and parks from 10 A.M. to 6 P.M., as well as special events. The program costs about $40,000 per year, with stables and private citizens donating most of the horses. In Providence, the downtown organization established a special charitable foundation to collect money for purchasing horses and supplies. Local equestrians helped train both the horses and the police.

Transportation. In many cities, transportation problems often seem insurmountable. There never seems to be enough parking, and streets are too narrow to handle the flow of traffic, yet maintaining an effective public-transit system is difficult and expensive. Most downtown organizations lack the staff, money, and expertise to improve transportation systems directly, but this doesn't mean they can't become involved in seeking and implementing solutions. Indeed, such organizations are well placed to look broadly at all transportation problems and potentials, and they can bring together the traffic engineers, transit operators, and, particularly, corporations and merchants whose success so hinges on improving people's access to the downtown area. The organizations can best help with such programs as downtown shuttle buses, ride sharing, pedestrian and transit malls, parking management, and incentives for using public transit.



One of the pioneering transportation-management programs is in Hartford, Conn. The city has experienced an unprecedented boom in office construction: 3 million square feet of office space have been completed since 1980, equaling the total built in the previous 20 years. The program developed to handle the influx of new employees includes offering flexible work schedules to reduce rush-hour traffic, prohibiting parking and deliveries during rush hour, phasing out free employee parking to open up spaces for shoppers and to encourage car pools, van pools, and buses, and developing close-in commuter lots with shuttle buses to office buildings.

The City as Marketplace

Drawing people downtown to shop is a central concern in most cities. In developing management strategies to improve the retail environment, cities can usefully look for clues from the competition—suburban malls. Managers of shopping centers have long understood how to create safe, clean, comfortable, and lively places that attract people. However, downtowns should not merely be transformed into shopping-mall clones. Rather, they should offer an alternative that accentuates the excitement of the urban experience.

Examples of unique, exciting downtown retail areas include Pike Street Market in Seattle, the Cannery in San Francisco, Fanueil Hall in Boston, and Harborplace in Baltimore. Admittedly, all these areas have the advantage of being privately managed, but they have certain qualities in common. All offer a wide selection of events and things for browsers to look at and do, including food vendors and performers, as well as places for people to sit and watch. The managements of these areas have also made conscious design decisions to concentrate people and activities in certain areas, creating the feeling of being in a marketplace.

The excitement of a markeplace depends on what takes place in an area's streets, plazas, and sidewalks. Many "new" strategies to create this excitement are really based on restoring what used to happen in cities—bringing back pushcarts, suggesting that restaurants put tables and chairs outside, encouraging street performers, recreating the traditional farmers' markets, and scheduling special events

Continued on page 60

Cities often hold special downtown events such as street fairs, sidewalk sales, and ethnic festivals for their intrinsic value. However, properly programmed, such events can attract people to underused areas or at inactive times, making the downtown more lively and improving its security.

From top to bottom: Christmas parade in Dayton, Ohio. Mime in Exxon Park, Rockefeller Center. Dallas Ballet at Cityfest, sponsored by Central Dallas Association.

Merchants fear street vendors will draw customers away, but in fact they often help downtown businesses.

Left: Buildings with blank walls or parking garages at ground level, rather than shops that open onto the street, are inhospitable. People tend to walk faster past such locations, and sidewalks become thoroughfares rather than places to stroll and window shop.

Many "new" strategies to bring excitement downtown are actually based on restoring what used to happen in cities — bringing back pushcarts and encouraging restaurants to put tables outside. Above: Farmers' market operated by Greenmarket in New York City.

A World-Class Economy: Getting Back into the Ring

BY LESTER C. THUROW

Despite the recent recovery, the U.S. is being beaten in international competition. We need coherent industrial policies now more than ever before.

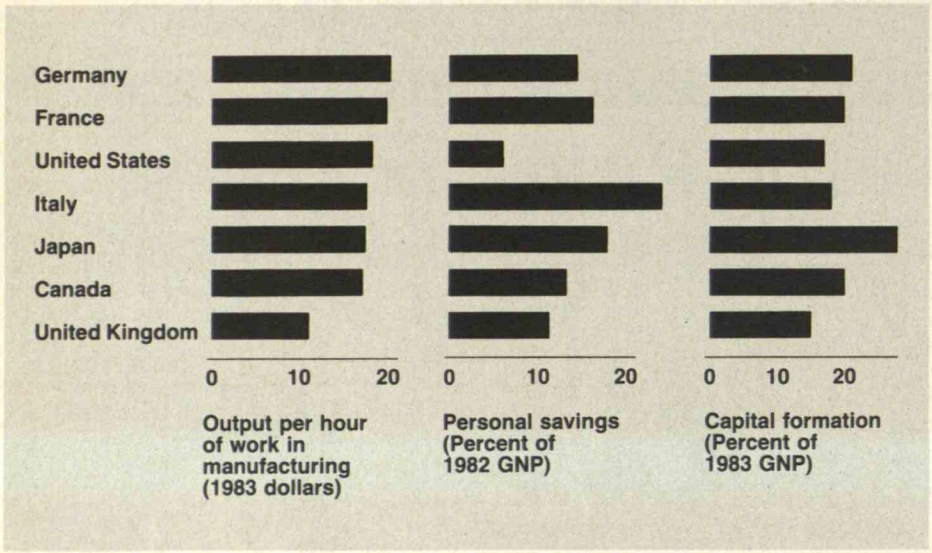
By now it is clear that our economic recovery from the latest recession is neither permanent nor robust. We can no longer afford to ignore the fact that U.S. industry is being beaten up in international competition. The huge technological edge enjoyed by Americans in the 1950s and 1960s has disappeared, and the United States is now faced with foreign competitors who have matched its economic achievements and may be in the process of moving ahead. With a balance-of-trade deficit of $123 billion in 1984, the U.S. economy is running on borrowed money. If present trends continue, our standard of living will fall behind that of the world's new industrial leaders, and we will join the ranks of countries such as Egypt, Greece, Rome, Spain, and England—nations that once led the world economically and politically but no longer do.

The central task of the next quarter-century will be to regain our industrial competitiveness in international markets. And to achieve that, the United States will require coherent, visible, and highly effective industrial policies. By industrial policies, I do not mean detailed central planning, but a cooperative relationship in which government, labor, and industry work together to create competitive, world-class industries. Contrary to the prevailing belief, some of the major U.S. economic successes have been due to specific industrial policies. In industries ranging from agriculture to rail transportation, the United States has relied on industrial policies to make it great.

Of course, industrial policies are not a magic answer to our economic problems. They are not substitutes for a good educational system, adequate savings and investment, low interest rates, a competitively priced dollar, and better macroeconomic polices. No industrial policy can succeed with a dollar as grossly overvalued as it is today. Nor can one succeed with real interest rates as high as they now are, or with an economy that runs on a stop-and-go cycle of recession and inflation.

If the United States is going to have a competitive economy, it will have to bring each of its major economic components—labor, investment, technology, macroeconomic policies—up to world-class standards. The only claim for industrial policies is that they can be a vital addition to these other crucial measures. If carried out in conjunction with them, such policies can help restore America's lost economic eminence.

ILLUSTRATIONS: KEN CONDON



Productivity — output per hour of work — is a good measure of the U.S. ability to compete in world markets. And the comparison with other countries is not very comforting (far left). Germany and France have already surpassed us in manufacturing productivity, and Italy and Japan are not far behind.

If U.S. companies want to stay competitive, they must invest more in plant improvements and equipment. And to invest more, Americans must save more. Americans rank far below other countries in personal savings (middle), and somewhat below in the amount they invest in new plants and equipment as a percentage of GNP (left).

A Stagnant Rate of Productivity

Productivity—output per hour of work—is a good measure of the U.S. ability to compete as a high-wage country in world markets. If American productivity is not equal to that of the best, the United States can compete only on the basis of wages that are lower than those of the world's productivity leaders. And that is hardly a solution that would be embraced by most Americans.

Manufacturing is probably the best arena in which to compare our performance in productivity with the rest of the world. Manufactured products account for 80 percent of our exports, and it is relatively easy to measure productivity in that field. The comparison is not very comforting. Germany and France have already surpassed the United States in manufacturing productivity. Where U.S. workers were producing $18.21 of output per hour of work in 1983, German workers were producing $20.22, French workers $19.80 and Italian workers $17.72. While the average Japanese productivity is still slightly inferior to that of the United States—$17.61 of output per hour of work—the productivity in Japan's key exporting industries (steel, autos, and consumer electronics), is second to none.

The data on comparative rates of productivity growth are even more disturbing: there is a real danger that the United States will soon fall from relative parity to inferiority. From 1977 to 1983, American productivity grew at the rate of 1.2 percent per year—one-half Germany's growth rate of 2.4 percent, one-third France's rate of 3.5 percent, and one-fourth the Japanese rate of 3.9 percent. In 1983, a cyclical recovery generated a better productivity performance in all of these countries, but the United States was still near the bottom of the international rankings on productivity growth.

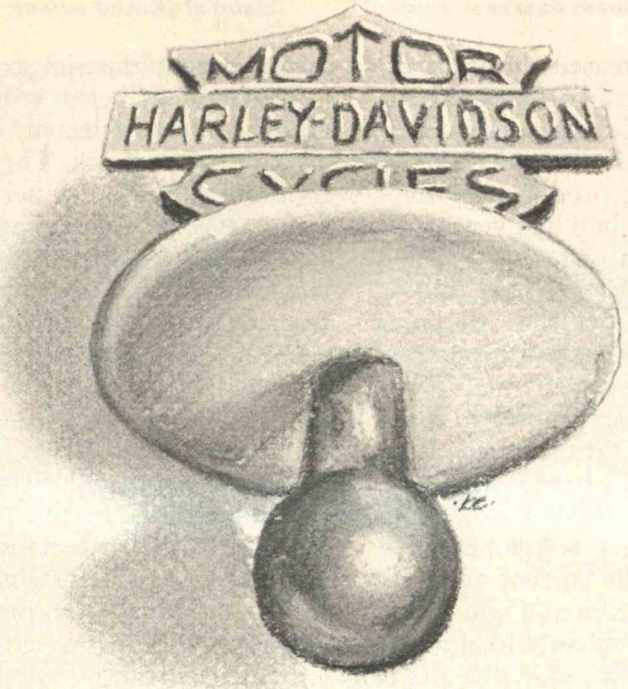
Until the 1980s, we could argue that the United States was experiencing an accelerated product cycle. What used to be high-technology products (steel and autos) had become low-technology products, and as such they were moving abroad to low-wage foreign competitors. This thesis now becomes much harder to sustain, for the United States is seemingly losing its competitive advantage in high-tech products. While we are familiar with the need for old industries such as steel and autos to resort to protection from more efficient foreign competitors, the same phenomenon is now visible in the high-tech industries that are supposed to be our economic salvation.

For instance, the Japanese have captured 70 percent of the market for 64K RAM semiconductor chips and seem likely to do just as well with the new 256K RAM chips now coming onto the market. Videocassette recorders—the leading new consumer electronics product—are 100 percent imported. In 1984, the Japanese manufactured 24 million video recorders, almost 10 million of which were sold here. Japan also seems to have conquered the market for assembly-line robots. All of this represents many lost U.S. jobs.

The United States is losing out not only to the low-wage countries of the Third World but to high-tech, high-wage rivals in the Europe and Japan. We

DIAGRAM: OMNIGRAPHICS

Asking for protection is easier than taking the tough steps necessary to become competitive.



are being whipped on the front as well as the tail end of the economy.

Can We Survive on "Service" Alone?

Some observers believe that the United States could survive as a service society, even if it relinquished its role as a competitive manufacturer of electronics and other high-tech products. In other words, even though we wouldn't be able to build computers, we could remain a force by doing the programming.

There is little reason to believe that this is a viable vision. The United States needs manufacturing jobs if it is to have full employment. Furthermore, many of our service firms exist to service manufacturing. Without manufacturing, what would become of communications, transportation, utilities, finance, insurance, and legal and accounting services?

In the case of the computer industry, the people who build the hardware are going to dominate the software market. Once another nation achieves dominance in hardware manufacturing, it will have little incentive to continue releasing information on the internal architecture of its computers, which is essential for developing software.

We have only to look at Great Britain to see what happens when manufacturing collapses. While London is still a financial hub, its decline as a major financial center is directly traceable to the decline of British industry. As U.S. industry declines, we will also see a decline in the institutions that serve it. American banks, for example, will obtain some business from foreign manufacturing firms, but most of this business will go to foreign banks. If anyone thinks otherwise, remember the large equity positions that Japanese, German, and French banks hold in their industrial firms. Since they own many of these firms, foreign banks are in a position to insure that American banks receive only the crumbs from foreign companies—regardless of whether these companies are operating inside or outside the U.S.

Once U.S. manufacturing collapses, there is no reason to believe that American service industries will fare any better in international competition than they do today. Japanese banks are very good, and the world's largest advertising agency is Japanese. The structural weaknesses of U.S. manufacturing — short-term horizons, poor labor-management relations, under-investment in R&D—will probably also plague service firms.

Like it or not, if U.S. manufacturing goes down the tubes, most of the rest of us will go down with it. We either rebuild the American economy together or we will all fail separately.

Making Industrial Policies Explicit

The real question is not "should America have industrial policies?" We already have industrial policies. There is no such thing as a democracy without industrial policies. Every tariff on imported motorcyles and cheese, every trigger price protecting steel, every corporate bailout for Chrysler and Lockheed, every import quota on autos and textiles, and any government allocation of private credit is an implicit industrial policy. The real question is: should the U.S. have effective front-door industrial policies with which we consciously attempt to build a world-class economy, or should we have backdoor policies with ad hoc, case-by-case strategies that prop up losers? By failing to admit what we are doing, we unconsciously design a blueprint for failure.

The nature of the problem is obvious in the policies of the Reagan administration. This administration argues that the United States does not need an industrial policy since all government has to do to guarantee economic success under capitalism is to keep out of the way. Despite these views, the administration has adopted an ad-hoc industrial policy. In

Deliberate industrial policies gave us an agricultural industry that is still the world's most efficient.

early 1983, for instance, it increased the tariff on large motorcyles from 4.4 percent to 49.4 percent. How is a tariff on large motorcyles supposed to help us regain our competitive edge in that industry?

In a good year, the only U.S. producer, Harley-Davidson, makes 50,000 cycles. In a bad year, such as 1982, it sold 32,400. By contrast, the Japanese make 7.1 million motorcycles and export almost 900,000 to the United States. Given that the Japanese have been a serious competitor in motorcyle production for decades, why should anyone believe that a protective tariff for two years is going to make any difference? What is Harley-Davidson promising to do differently from what it has been doing?

We have had an industrial policy of protecting steel since 1968, but the industry is competitively weaker than it was then. Yet the current administration has just added special tariffs and quotas for specialty-steel products. The problem with protection unaccompanied by any explicit quid pro quo is that it is always easier to come back for more protection than to take the tough steps necessary to become competitive in the world market.

A U.S. Success Story

Agriculture is the industry in which we now enjoy our greatest competitive advantage in world trade. Only 3 percent of the labor force accounts for almost one-fifth of our exports, and it would account for much more if foreign markets were completely open to American products. Agriculture is also the U.S. industry with the highest rate of productivity growth—a rate more than three times as high as that of nonfarm businesses since World War II.

What Americans tend to forget is that U.S. agriculture was not always a success story. In the nineteenth century Russia—not the United States—was the largest grain exporter in world markets. From 1900 to 1940, U.S. agricultural productivity grew at less than 1 percent a year, with essentially no growth in the first two decades of the century. In the 1930s, agricultural productivity was far below that of the rest of the economy.

Yet after 1940, agricultural productivity grew at more than 6 percent a year, and the gap between agriculture and industry quickly narrowed. This dramatic improvement depended not upon good soil, a favorable climate, or hardworking farmers—all three existed during the period of failure—but upon an elaborate industrial strategy.

This strategy began with R&D. The federal government invested heavily in basic research at state agricultural colleges. The results (new seeds, new procedures) were further refined at experimental state farms, and county agents roamed the countryside explaining the new developments, providing technical aid, and attempting to persuade individual farmers to use the discoveries. While some of the elements of this strategy (the land-grant colleges) were in place before the Great Depression, none achieved a big payoff until coordinated with other ingredients in the 1930s.

This deliberate industrial strategy encouraged major investments in the physical infrastructure of farming. Water-reclamation projects led to massive increases in irrigated farming. Federal incentives encouraged conservation projects such as windbreaks and contour plowing—efforts that would pay off in long-run gains in productivity.

The Rural Electrification Agency (REA) was set up to bring electricity to every farm in the United States through low-interest loans. Farmers made enormous gains in productivity when they were able to use electrical machinery. To help farmers finance their land and machinery, a plethora of new financial institutions was developed—some public, some quasi-public, and some private but all offering government loan guarantees. Federal crop insurance, export credit, and the Farmer's Home Administration were only a few of these institutions, many of which were started with public money and are now self-financing.

Efforts were also made to stabilize farm incomes and outputs with price supports and acreage controls. These programs were not run perfectly—they allowed grain reserves to climb too high in the 1960s and drop too low in the early 1970s—but they had an important effect on farm productivity. With more certainty in their incomes, farmers were willing to invest heavily in new equipment. Knowing there would be income to repay those loans, banks were willing to help finance the new equipment, and makers of farm machinery could gear up for massive production runs to meet the demands of a stable market, thereby reducing unit costs.

Today the agricultural industry is again in trouble because of the overvalued dollar, but that is another story. The important point is that what started as a desperate effort to prop up a large, sick enterprise

The elaborate U.S. strategy to save the agriculture industry began with R&D. The government invested heavily in basic research at state colleges and experimental farms. It then hired county extension agents to carry research results to farmers. Below: Farmers harvest a new variety of seedless watermelons developed at Purdue University in Indiana.

A researcher examines a new variety of grape grown at the Agriculture Department's Research Center in Beltsville, Md.

PHOTOS: JOHN DOMINIS

in the 1930s ended with an industry that is still the world's most efficient. And while most of us are not farmers, we have all benefited from the low-cost agricultural products that resulted from these industrial policies. This is an American success story, and U.S. history is full of such examples. Similar stories can be told about the Erie Canal (backed by the state of New York), the Western railroads (financed with federal land grants), and the Tennessee Valley Authority (TVA).

An American MITI

The U.S. Defense Department has often played the role of Japan's Ministry of International Trade and Industry (MITI). For instance, the department is financing a fifth-generation computer project and a very large scale integrated semiconductor project to match those of the Japanese. It has programs to encourage innovations in production processes and to speed the installation of these new processes once they are perfected. But, of course, 90 percent of the department's money goes to develop and test military projects that bring little benefit to the civilian world. A MITI hidden in the Defense Department is


THE "SPIGOT" THEORY OF THE MEGABIT CHIP.

There are megabit chips. And there are megabit chips. All of them can access more than 1 million bits of information. But not all of them can access these 1 million bits of information AT&T fast. And fast to AT&T is 20 million bits per second.

That means we can pour out 1,048,576 bits much faster than you can say "byte." And we can do it because only the AT&T megabit chip has a fast column access mode.

The "Trickle-Down" Theory Vs. The "Spigot" Theory

Most other megabit chips use a "page mode" to access their memory cells. When a chip is in this mode, its fastest data rate is about 10 million bits per second.

But the fast column cycle, developed by AT&T Bell Laboratories, pours out data twice as fast. And not only does data flow out faster, getting data out is easier with the fast column, because access timing requirements are less demanding. Valid data are always available during the entire access cycle.

And speed, ease of use and timing tolerance will make it easier for AT&T to design new and improved products and high-speed systems around the megabit chip.

The Megabit Special

Because this megabit chip is designed for manufacturability, you might want to know what, besides its fast column, makes it special. It's made using an advanced CMOS—Complimentary Metal-Oxide Semiconductor—process that makes it possible to provide high performance at reduced power consumption.

As a matter of fact, it uses 1/8 the power per bit of most 256K DRAMs. The lower power requirement is a plus for any system using the megabit—allowing for lower operating costs and reduced cooling requirements.

The AT&T megabit chip is smaller than a dime, yet has more than 2 million elements on it. Among those 2 million-plus elements are more than 20,000 spare memory cells for safety's sake. If for some reason there's a bad cell in a chip, a computer-controlled test targets the cell—and its whole row or column—for replacement. A laser redundancy technique, pioneered by AT&T, then disconnects the offenders and automatically replaces the entire memory row or column from the spares.

Actual size

Cleanliness Is Next To Goodliness

A speck of dust on a megabit chip is like a boulder on a railroad track.

To keep our chip clean, it has to be made in a room that's C-L-E-A-N. And an AT&T class-10 clean room is one of the cleanest rooms in the world—where the air contains fewer than 10 particles of dust in a cubic foot of air. And the largest particle must be smaller than 1/150 the diameter of a human hair. That makes our room 10,000 times cleaner than a hospital operating room.

To keep our air clean, we have to keep it moving. Ours is constantly circulated and filtered by fans that could inflate the Goodyear blimp in only 30 seconds.

You Ain't Seen Nothing Yet

Looking toward the year 2000, today's technology predicts submicron design widths, with lines only 400 atoms wide. Chips containing 100 million components—50 times the current amount—could have tiny regions with capabilities that more than match the megabit chip.

Now we're talking computer POWER, because these new chips with micro-parts could work at picospeeds (trillionths of a second). Current estimates suggest 10-picosecond transistors.

AT&T will not let the chips fall where they may. We'll put them where they'll do the most good—in the powerful and reliable digital systems creating the general-purpose information technology we call Universal Information Services. Our continuing flow of advanced technology is one reason why AT&T is the right choice.

AT&T

The right choice.

better than no MITI, but it is not a substitute for the real thing.

In civilian R&D, our competitors are now outspending us. During the 1970s, the United States spent 1.5 percent of its GNP on civilian R&D while Germany was spending 2.0 percent and Japan 1.9 percent. The French have also recently eclipsed us in spending on civilian R&D.

The U.S. problem is not just too little spending. If one looks at the mix of spending, American firms do an adequate job of financing R&D that will quickly lead to marketable products. Our most serious failure is in research that would lead to new processes for making old products, or to new products that are five to ten years from marketability. Process research often pays off for the economy much more than new products. The profits from new products are always small in relation to the total economy and often take decades to have a significant impact on national economic performance—as did those from the computer. In contrast, a new process for making old products can have a big impact, since the markets for many old products are already large. It is also usually easier to copy a competitor's new product—you buy one and tear it apart—than it is to copy a new production technology. You cannot buy it, and the competitor usually will not let you look at it.

U.S. firms have ignored process R&D for a number of reasons. Prestige has gone to those who developed new products rather than those who have been the cheapest producers of old products. Profit margins were thought to be higher on new, unique products than old, competitive ones. While this may have been true in the past, it is now clear that with foreign competition higher profit margins on new products do not last anywhere near as long as they used to. As the Japanese have shown, the long-term profits go to those with the lowest production costs, not to those who make the original discovery.

Government has been reluctant to finance process R&D because such an effort can too easily be used to subsidize particular companies. However, the government could avoid favoritism by limiting its financial aid to cooperative ventures that involve firms willing to pay their share of the expenses. To ensure that firms choose feasible goals, the government could finance no more than 50 percent of any industrial R&D project. Antitrust laws have historically discouraged such cooperative efforts, but this

PHOTO: DENNIS BLACK

Even high-tech companies seem to be losing their competitive advantage to Japan and Europe.

handicap has now been essentially removed.

The advantage of partially government-funded cooperative projects is that they could be subject to peer review before they were funded, much the way research supported by the National Science Foundation must be approved. That would ensure a wise investment of government money. Also, participating firms would police one another to make sure their money and the government's do not become de facto operating subsidies for any one firm.

To set up such cooperative ventures, and indeed to compete successfully in today's high-tech world economy, the United States must establish a civilian agency of industrial technology—a National Science Foundation for the business community. Such a civilian ministry could more easily coordinate R&D ventures and spread new technological information than individual firms.

The American machine-tool industry provides a good example of the need for such an agency. This industry has historically been highly fragmented, conducting little basic research and development. The Germans have always been formidable competitors in machine tools, but the Japanese are now threatening to drive both the Americans and Germans out of the market with lower costs and superior products. Yet machine tools are clearly a key to competitiveness in high-tech manufacturing, and no one wants to fall substantially behind in producing them. A series of cooperative, partially government-financed R&D projects would help solve the problems of the American machine-tool industry.

An Industrial Policy for Steel

Industrial policies do not exist to choose the "sunrise" industries of the year 2000. That is impossible; no one knows what they will be. The aim of industrial policies should be to strengthen new high-tech industries, to restructure old industries into world-class competitive entities, and to manage decline where decline must occur.

Consider the ingredients of an effective industrial policy for steel. It would start with the realization that some part of the steel industry—standardized low-tech products—should and will move off to low-cost foreign producers in Korea and Brazil. An industrial policy would help workers move out of these areas of production and into other good jobs. In the part of the industry that is viable—as are mini-mills that use electric furnaces and scrap iron—an industrial policy would expedite decisions about sites and compliance with environmental regulations, and get those mills into operation as fast as possible.

The high-tech, "sunrise" component of the steel industry—or, more broadly, metals industry—is in powdered metals, metal ceramics, and other new products of materials science. The few big steel companies that might be able to finance R&D in these areas have essentially decided to abandon this part of the industry. That may or may not be a good idea, but it is clear that the United States cannot afford to abandon the materials industry. We need the jobs, but even more importantly, materials science is one of three hot scientific areas—the other two being electronics and biogenetics—that are about to yield new applied products. An industrial policy in this sector would coordinate and help fund the necessary R&D, and then provide partial financing for constructing needed facilities.

An industrial policy would also remove all protection and make clear that protection would not be reconsidered until the leaders of the steel industry came up with a concrete plan to remake their companies into a competitive world-class industry. With such a spur, I would bet that the necessary planning could be done in less than a month. The problem has not been "what should we do?" but rather that "doing it is too painful!"

The Case for Investment Banking

To be competitive in world markets, the United States will also have to reinvent investment banking. Investment banks are those that can accept deposits from the public and use them to take direct ownership positions in industrial firms—rather than just loaning money to such firms.

Investment banking was abolished in the United States for misguided reasons. Private investment banks were made illegal in 1933 because many were thought to have made scandalous financial speculations that precipitated the Great Depression. We now know that the speculative excesses of the investment banks played only a very small role in the onset of the Depression. Yet such banks played a key role in many pre-Depression ventures.

After World War II, the lack of investment banks was not a serious problem because the industrial community was profitable enough to be essentially

An industrial policy would help bring new steel mills into operation as fast as possible.

self-financing. Profits from one generation of products were high enough to finance the next generation of production facilities. But the era of self-financing is over. The technological lead that produced such high profits is disappearing, and U.S. firms find they cannot accumulate the funds necessary to build the next generation of facilities.

The problem can already be seen in the American semiconductor industry. Semiconductor firms are in the process of shifting from chip technologies with relatively low demand for capital to very large scale integration technologies with much higher demand for capital. Japanese semiconductor firms can rely on local investment banks to lend them a massive amount of the money they need (up to 95 percent) to build the required new factories. These firms do not have to use profits earned on old products, and thus can set prices aggressively to drive competitors out of the business. This is precisely what Japan did in the shipbuilding, consumer electronics, and steel industries, and what it is now doing in the automobile industry. Why should the results be any different in the knowledge industries—the announced Japanese industrial targets of the 1980s? Our firms are now reduced to asking the Japanese government to restrain Japanese investment in new facilities.

To a limited extent, U.S. investment banking has been reinvented under the name of "venture capitalism." Venture-capital funds have risen from essentially zero in the mid-1970s to $3 billion in 1984. However, venture capitalists do not have the resources to make major investments in the next generation of integrated steel mills, for example, each of which might cost $5 billion.

Public investment banking is needed along with private investment banking for a number of reasons. In the 1930s and 1940s, public investment banking played an important role in the American economy. For instance, the Reconstruction Finance Corp. financed the establishment of the aluminum industry—except for Alcoa—as well as much of the expansion in production facilities during World War II. But public investment banking was abolished in the 1950s because it was accused of favoritism in its lending policies. It was also seen as socialism at a time when the Cold War was at its height.

Public investment banks can require lower wages, fast state and local decision making, new managers, and outside investment that private investment banks cannot and will not insist upon. The federal government is already heavily involved in allocating capital—to the tune of $244 billion in existing loans or loan guarantees to U.S. manufacturing and service industries, as well as to state and local governments. It would be far better to establish this function in an investment bank and bring government involvement out of the closet. Public investments would thus have to be justified as part of the overall strategy to create world-class American industries.

If public investment banks were allowed to provide only partial funding for projects, the historical problems of favoritism and uneconomical investments would be largely eliminated. As I mentioned before, no project should be undertaken unless private investors are willing to risk a substantial amount of their own money.

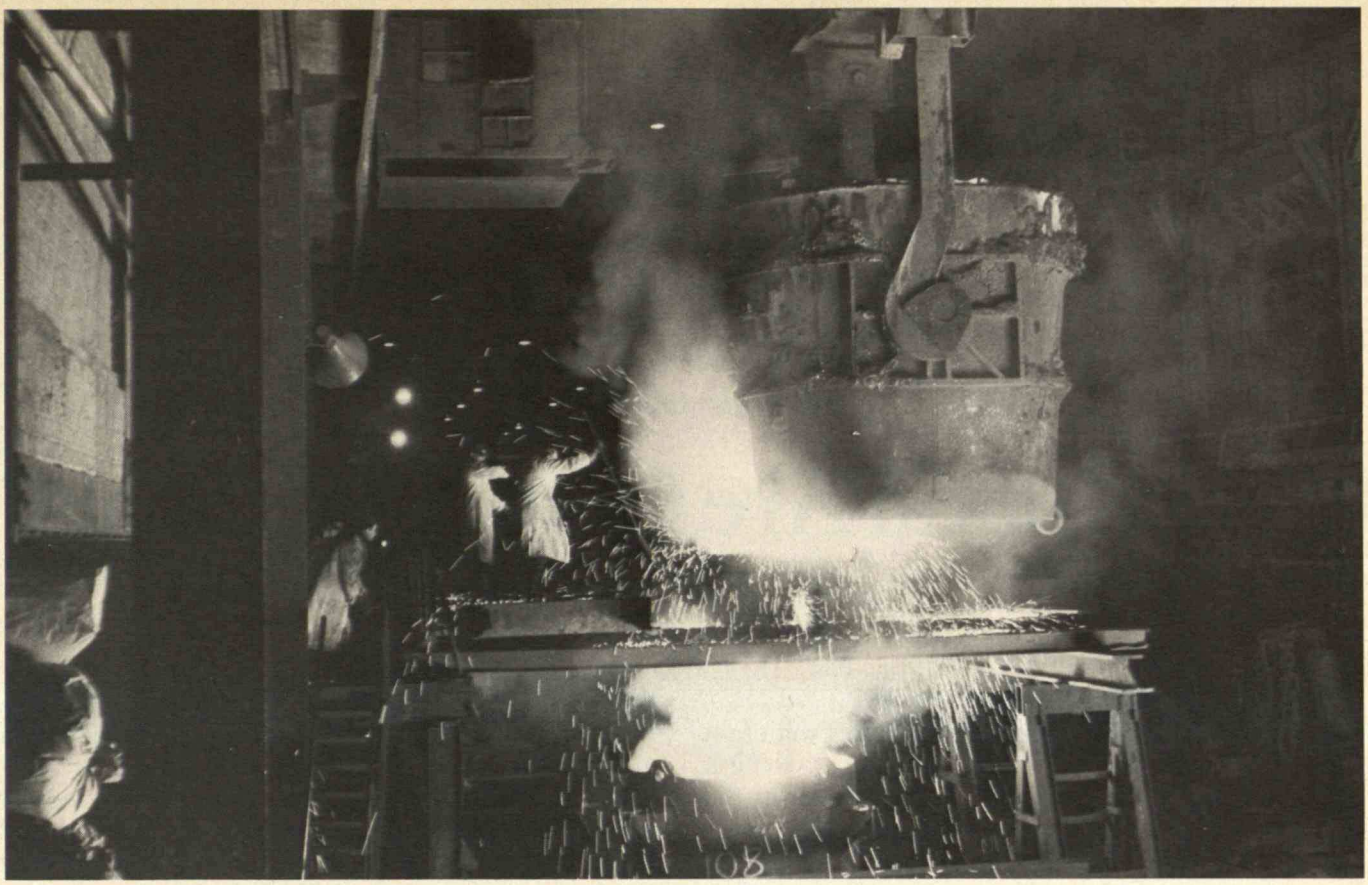
Making Industrial Policies Work

In most other countries, it would be completely normal to ask the members of a sick industry—the firms, unions, suppliers, banks, and communities—to sit down and determine what part of the industry could be saved and how it could work to strengthen itself. Competing firms, for example, might devise a plan to shut down their most obsolete facilities in a way that did not alter their market shares.

Under U.S. antitrust law, any such conversation would be considered criminal. We need to change such laws and reexamine some deeply entrenched perspectives. For instance, the populist strain in American history maintains that the only good economic and political relationships are adversarial. From this perspective, if government, labor, and business work cooperatively on any problem, they will end up screwing the common people.

As a result, labor is too often pitted against management, government against business, and business against itself. We have only to look at the debacle in the farm-machinery industry, where a very sick International Harvester showed incredible staying power by selling farm equipment below the cost of production. International Harvester eventually went out of business, but not before it had forced substantial losses upon John Deere and Caterpillar.

Industrial policies can help end such adversarial relationships by providing a framework where labor, management, and government can work together. Special provisions can be built into industrial policies to make "too cozy" relationships unlikely. As in the



case of Chrysler Corp., whenever the government, or rather we the taxpayers, provide aid of any sort, we should be compensated for the risks and costs incurred with equity participation in the industry. In return for furnishing Chrysler with $1.2 billion in loan guarantees, the U.S. government made $350 million when it sold its shares in the company. Such compensation should also be provided in return for protectionist measures, since—as in the case with automobile import quotas—they raise prices for the American consumer.

As also was done with Chrysler, the actions of corporate managers should be externally reviewed to determine whether they are part of the problem or the solution. Someone, presumably the current managers, led that industry into disaster. People who lead other people into disaster should be removed from leadership positions.

435 Districts or One Nation?

To make industrial policies work, Congress is going to have to exercise some self-restraint. The United States is not 435 congressional districts, but one nation that is in collective trouble. If Congress insisted that R&D or investment-banking funds be spent equally in each congressional district, industrial policies could not possibly work.

The next generation of steel mills, for example, must be built at coastal locations to be economically viable. These mills must be able to buy coal and iron ore from wherever in the world it is cheapest and transport it back at the lowest possible cost. This requires access to large ships. Hence, if Congress insisted on building new mills where the old ones are, they would be instant white elephants.

Furthermore, no industrial policy can work without the active support and cooperation of the president of the United States. If he or she is opposed or indifferent, the idea is simply not viable within our political structure.

The current administration assumes that if we play the free-market game we will be winners. Yet our $123 billion trade deficit is telling us that we are losers in the world market. At the end of the first quarter of 1985, American productivity was no higher than it had been at the end of the second quarter of 1984. Nine months with no growth in productivity is not a satisfactory performance, and the inevitable drop in our standard of living will make it obvious that the Reagan policies are not long-term solutions to the U.S. problems. We must develop alternative solutions, and explicit industrial policies should certainly be part of that package.

LESTER C. THUROW is Gordon Y Billiard Professor of Management and Economics at M.I.T.'s Sloan School of Management. *This article was adapted with the permission of Transaction, Inc., from* Society *(vol. 22, no. 1, copyright 1984 by Transaction, Inc.). Professor Thurow's ideas on industrial policy are also included in his upcoming book,* World Class: America in a Competitive World *(Simon & Schuster, 1985).*

PHOTO: FRITZ GORD, LIFE MAGAZINE/TIME, INC.

Disruptions in imports of critical metals from politically unstable countries will not shut down U.S. industry, as some observers fear. Instead, they will lead to conservation and materials substitution.

How Critical Are Critical Materials?

BY JOEL P. CLARK AND FRANK R. FIELD III
WITH JOHN V. BUSCH, THOMAS B. KING,
BARBARA POGGIALI, AND ELAINE P. ROTHMAN

How well could the United States maintain its economic vitality and military strength if cut off by international crisis from the critical metals it imports from overseas? This question is receiving a great deal of attention these days, particularly with South Africa's recent threat to stop sales of critical materials to any country that imposes economic sanctions against its apartheid regime. South Africa is a major supplier of chromium, manganese, and platinum, and some observers fear that a significant disruption in supplies of these materials would be disastrous.

The congressional Office of Technology Assessment (OTA) voiced just such a fear in a recent report on critical materials. After a detailed study, the OTA concluded that the "United States is likely to become more dependent upon imports of critical materials from potentially insecure sources of supply." And that dependence, according to the OTA, could put the nation in a vulnerable economic and military position—if there were significant disruptions in supply owing to a political crisis.

Each year the United States imports well over $1 billion worth of materials considered *strategic* because of their unique importance in the manufacture of defense munitions and industrial products, and *critical* because they are imported from countries with potentially unstable political regimes. The four commonly cited strategic and critical materials are chromium, manganese, and platinum, primarily supplied by South Africa; and cobalt, of which Zaire is the dominant producer. All four metals are thought to be essential to our national defense and economy since they are used in the production of steel and stainless steel, as well in the manufacture of high-temperature alloys for jet engines and gas turbines.

The U.S. government stockpiles these materials and others in varying amounts to assure at least minimal supplies to meet defense needs in times of crisis. The Reagan administration has begun to build up that stockpile and, in fact, has made the first stockpile purchases since 1962. But it continues to rely "upon the workings of the market" to assure the supply of such materials for civilian purposes.

Many observers advocate further action to reduce the nation's vulnerability to supply disruptions. Among proposals often made have been that:

- ☐ The federal government increase its stockpiling of critical materials to meet the needs of private industry as well as those of the defense establishment.
- ☐ The United States wield its political and economic power to bolster friendly governments in countries that supply significant amounts of critical materials.
- ☐ Government and industry support the development of alternative resources now untapped because their exploitation would be uneconomical or would cause significant environmental damage.
- ☐ The government fund research to develop new materials that can substitute for critical minerals.

In our view, the United States is needlessly concerned about the future availability of critical materials. We believe the existing stockpile, managed by the Federal Emergency Management Agency (FEMA), is adequate to deal with the threat of disruptions to national security. In the case of civilian industries, disruptions in supplies will automatically lead to conservation and recycling (a drop in demand), and to a much-expanded effort to develop alternative materials.

Thus, it is neither necessary nor economically sound for the U.S. government to increase its existing stockpiles or to invest heavily in untapped resources.

PHOTO: ALEX WEBB, MAGNUM

Zaire is the world's primary producer of cobalt, which it mines as a by-product of copper. U.S. cobalt supplies were disrupted in the late 1970s when a rebel tribe invaded the copper-mining province in Zaire. Because the metal is used to make military jet engines, some policymakers feared the crisis would jeopardize national security. But U.S. manufacturers turned to other materials, driving the price of cobalt down despite its scarcity.

Our existing emergency stockpile of chromium is more than adequate.

However, the government should fund R&D on alternative materials that not only will reduce our reliance on imported minerals but also will lead to improved performance and lower costs in manufactured products.

Reducing Our Fix on Chromium

The United States now imports about 99 percent of the manganese, 95 percent of the cobalt, 82 percent of the chromium, and 90 percent of the platinum-group metals (PGMs) that it requires. We prefer to purchase these materials at international market prices rather than exploiting higher-priced alternatives from domestic or "reliable" foreign sources.

The most important supplier of chromium is South Africa, which accounted for 35 to 40 percent of world production in the early 1980s. Next comes the Soviet Union, which is responsible for 25 to 30 percent of world production. Other important suppliers are Zimbabwe (formerly Rhodesia), the Philippines, and Turkey.

Chromium is used in metal alloys (stainless steel), chemicals (such as paint additives), and high-temperature refractory applications, such as in bricks that line industrial furnaces. About two-thirds of the chromium imported by the United States is in the form of high-grade ore used for metallurgical applications. Of this, about 70 percent is used to make stainless steel, a corrosion-resistant alloy containing a minimum of 12 percent chromium. Another 15 to 20 percent is used in other steel alloys in which chromium increases strength, heat resistance, and flexibility in shaping the metal. Less than 5 percent of U.S. chromium is used for superalloys—the nonferrous materials that are resistant to extremely high temperatures and used chiefly in gas turbines.

Metallurgical-grade chromite ores are found primarily in the Soviet Union, Turkey, and Zimbabwe. South Africa supplies the lower-grade ores used in pigments and paint additives. However, recent technical advances have also made it possible to use these ores in metallurgical applications. As a result, South Africa has assumed an increasingly important position in the world market.

There is essentially no substitute for chromium in stainless steels and superalloys, since it provides resistance to corrosion and oxidation at high temperatures. According to some estimates, only 10 percent of chromium could be eliminated by replacing cobalt-based superalloys with nickel-base superalloys, which contain less chromium, or by applying protective surface coatings to alloys that have less chromium. Furthermore, the costs of substitution would be very high because intensive tests would be required to certify these new materials for use in military aircraft and gas turbines. There would also be a three- to five-year lag before these substitutions could be made.

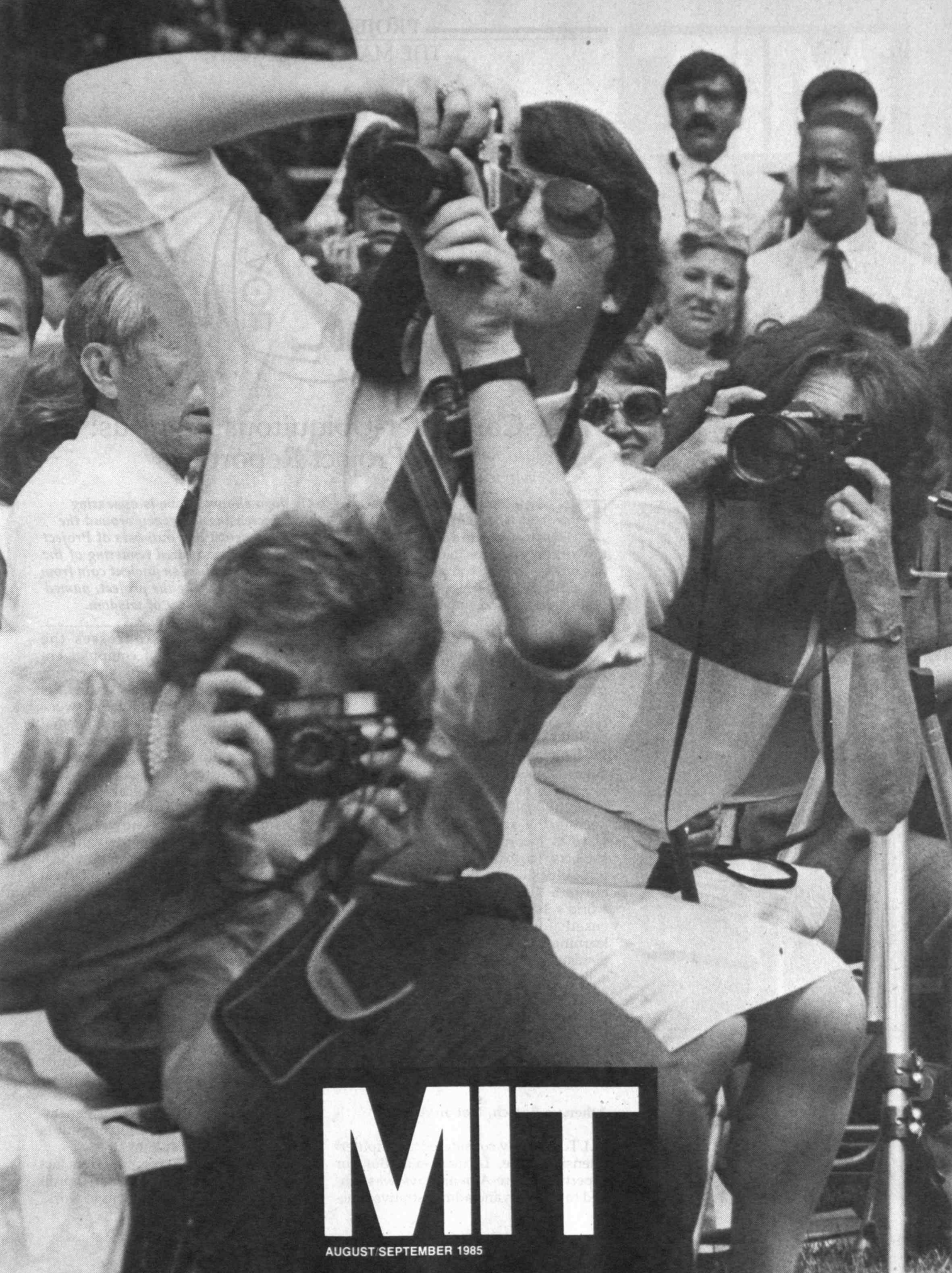
However, there are significant opportunities for "secondary substitution"—eliminating stainless steel entirely and using other steels of lower chromium content. For example, stainless steel is used for largely aesthetic reasons in architecture, furniture, automotive trim, and kitchen utensils. Aluminum, coated carbon steel, and plastics could easily be used instead, albeit at somewhat higher prices. Stainless steel could also be replaced by titanium and composite materials in oil-drilling rigs and chemical-processing facilities, again at somewhat higher prices. Copper or carbon steel encased in stainless-steel claddings, copper and nickel alloys, titanium, and plastics could be used for stainless steel in certain industrial equipment, fasteners, and automotive parts. Chromium could also be conserved in the production process.

Indeed, we estimate that a 50 percent increase in the price of stainless steel would result in an overall decrease in chromium consumption of 25 percent after one year and 35 percent after four years. The market essentially would take care of itself, which is why the existing emergency stockpile of chromium—5 million tons—is more than adequate.

Conserving the Manganese in Steel

An essential ingredient in modern steel making, manganese is used to remove the sulphur from unrefined iron. The chemical industry also uses manganese ore, especially as an electrolyte in dry-cell batteries.

The Soviet Union is the world's largest producer of manganese, but East-West trade in this metal has historically been minimal. The most important source for the noncommunist world is again South Africa, which accounts for about 36 percent of supply. Furthermore, South Africa has more than 75 percent of the noncommunist manganese reserves. Brazil, Australia, and Gabon are sources of about equal importance, each accounting for about 15 percent of noncommunist supplies. The United States



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ABOUT THE COVER
Leading the Commencement procession towards those avid photographers was Mary Frances Wagley, '47 (above), during 1984-85 the first woman president of the M.I.T. Alumni Association. Photo by Donald M. Davidoff, '86.

A Computer-Ubiquitous Campus: A Project Report

The logo shown above is appearing with increasing frequency around the campus, identifying outposts of Project Athena. It is a stylized rendering of the owl motif found on an ancient coin from Athens—a city, like the project, named for the Greek goddess of wisdom.

President Paul E. Gray, '54, has described it as perhaps "the largest step forward in M.I.T.'s long history of contributions to education." Media reports depict computer heaven in the making, right here at M.I.T. And to other colleges and universities, it must seem that Project Athena has absolutely everything going for it.

Athena is the Institute's five-year program to introduce networked personal computers throughout the undergraduate curriculum. When it was announced in the spring of 1983, IBM and Digital Equipment Corp. had committed $50 million in hardware, software, maintenance, staff, and other support to the program. The Institute proposed to raise an additional $20 million to install and operate the system and develop new ways to incorporate it in all academic subjects. Furthermore, M.I.T. has a faculty and student body reputed to include a substantial fraction of the world's hackers. And our goal is focused: to enhance the teaching and learning process—not research, and not development of hardware or software.

But it turns out that money, talent, and commitment only make the task possible, not easy, as Professor Steven R. Lerman, '72, director of Project Athena, explained at an early spring workshop for members of the Industrial Liasion Program.

Athena a Search, Not an Answer

M.I.T. is rightly considered a computer-intensive place, Lerman said. But our expertise in pre-Athena days was limited to research and administrative functions. This project addresses the question, "What sort of computer environment would best serve the educational needs of the Institute?" Athena is really the search, not the final answer.

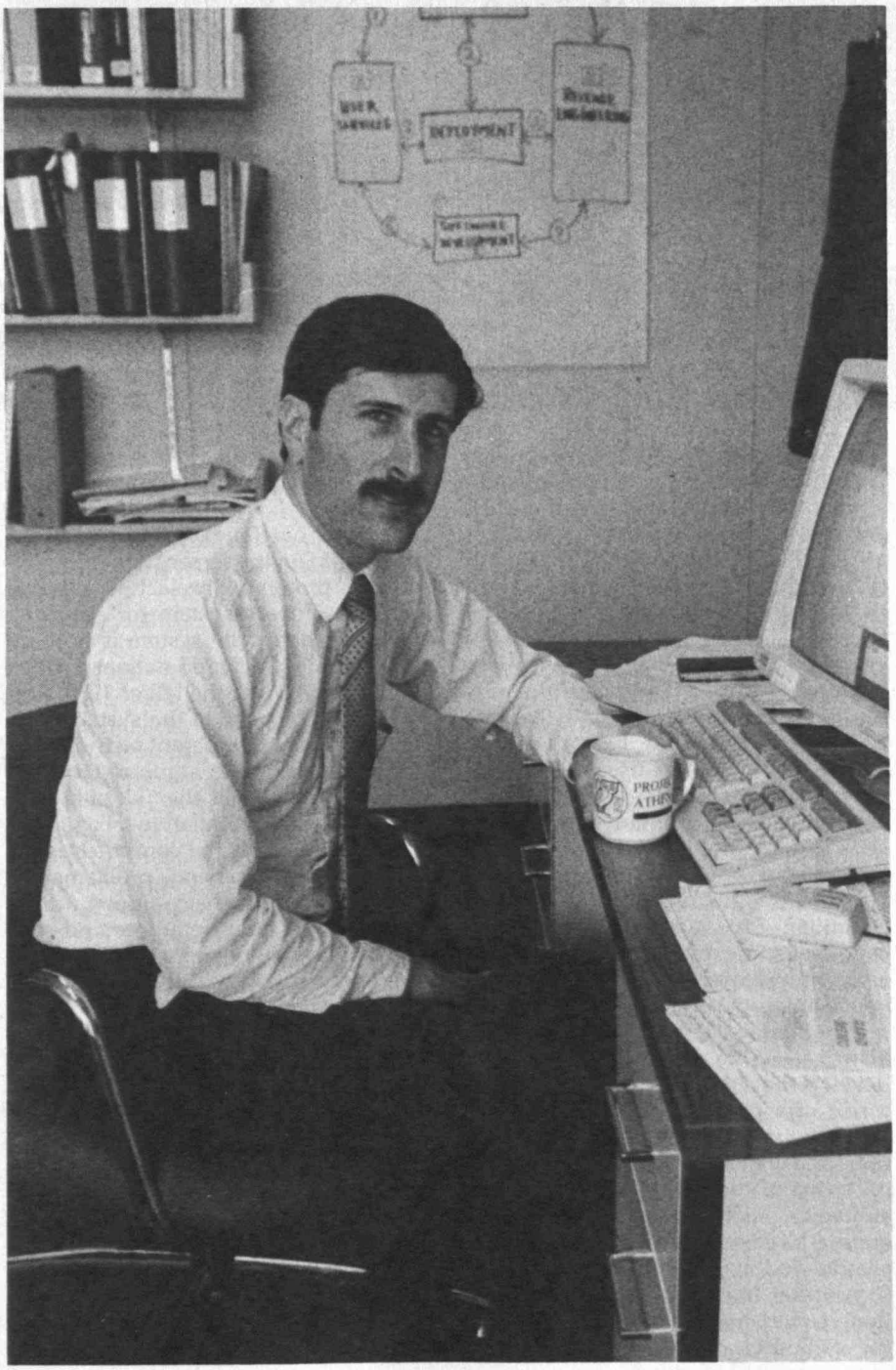
The original Athena task force headed by Gerald L. Wilson, '61, dean of engineering, laid out four critical elements: First was industrial participation to provide hardware and technical expertise. In addition to Digital and IBM, the industrial participants now include Codex, which works on networking, and Bolt, Beranek and Newman, which works on technical problems. Digital and IBM each support teams of five staff members based on the campus and are supplying maintenance for their equipment over the life of the project. Codex and BBN have smaller complements.

Second, M.I.T. was committed to incorporating this hardware into a campus-wide network with as many as 2,600 high-performance work stations.

The third element was coherence, which Lerman describes as an abstract label covering a series of software interfaces. These enable users to perceive a heterogeneous pool of several generations of hardware from multiple vendors as a single, unified system.

And finally, M.I.T. committed its faculty to developing the educational projects that would put the system to work.

You can measure the dependence on Athena by the loudness of the screams when something goes wrong.



Some 175 to 200 faculty-years will be spent developing curriculum, supported by about half the $20 million M.I.T. is in the process of raising as its contribution to Athena. The funds pay for release time, programming, and software documentation.

What Athena Is Not

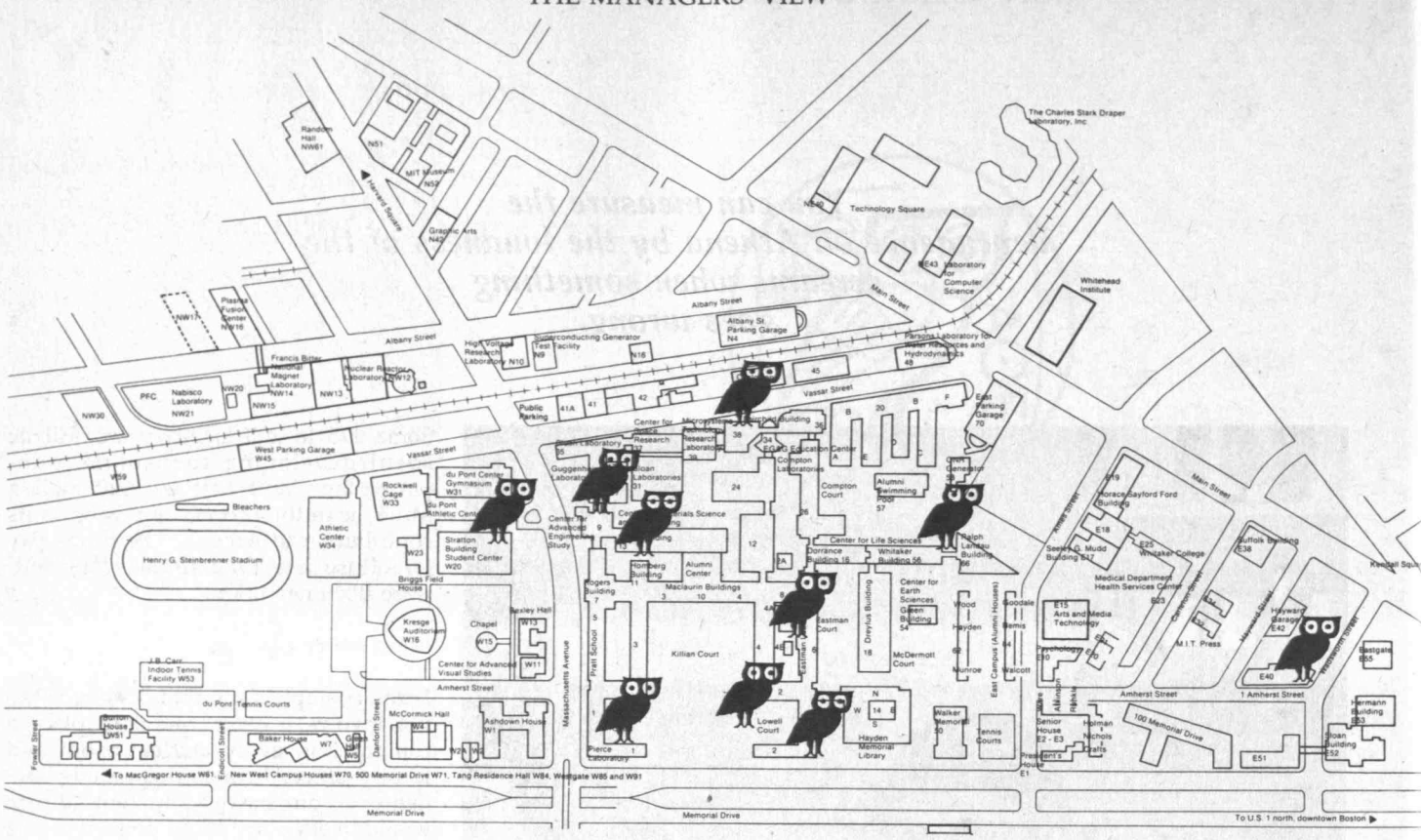
Lerman emphasizes that Athena does not involve a commitment to place a computer in every student room and faculty office. It does not require students to purchase equipment, which would in effect saddle students with the experimental cost. It is not a project for proprietary software development; everything designed in Athena, even by the industrial employees, is the property of M.I.T. And Athena is not a vehicle for increasing the amount of computer programming in the curriculum; programming is used to learn other subjects, not as an end in itself.

Athena has two phases, influenced by the equipment available. The schedule called for deploying Phase I equipment in 1983 and giving the faculty about a year to develop curriculum projects. Meanwhile, the staff would plan for deploying of a more final form of the work stations in Phase II. The curriculum projects would be introduced into the classrooms while the transition to Phase II equipment got underway, sometime in 1985. It didn't happen.

Many faculty members, who obviously had been thinking about how they would like to use computers in their classes, were only waiting for the resources to be made available. They submitted 35 proposals that were approved in the first round of submissions, and there was pressure to introduce many of these new materials into the classroom a full six months ahead of schedule. While the Athena staff responded to this unexpected enthusiasm, planning for Phase II fell behind.

Steven R. Lerman, '72, Athena Director

PHOTO: FRANK REVI '86



THE WIRED CAMPUS: The owls pinpoint clusters of Athena machines to which students had access as of June '85. There are also Athena machines in the departments, in varying concentrations, to enable faculty to develop new subject materials. The fibre optics cable that ties the machines into a network snakes from Athena headquarters in E40 to the Student Center and then over to Technology Square on Main St.

After that delay, the schedule fell into a Gordian knot. Delivery of some third-party components required by IBM to produce the experimental "future work stations" was held up, and IBM hurried to supply enough PC/ATs to fill the gap. That meant that the Athena staff was taxed further, having to both stretch the available Digital machines to meet demands on the system and develop a strategy for evolving from PC/ATs to the future work stations.

There have now been four calls for projects, with 69 approved. M.I.T. has committed about $3.4 million to provide release time and technical support to faculty developing these new applications. Every school but Sloan (which operates its own independent computer project with IBM) has several projects underway.

Lerman has observed patterns in the way M.I.T. faculty use the computers. All depart from the computer-aided instruction (CAI) movement of the 1960s and early 70s that Lerman characterizes as the "skill and drill" model. In CAI, the computer controls the dialogue and the student's job is merely to give a response indicating that he or she understands. That approach was totally unsuited to M.I.T.'s objectives of presenting abstract material and teaching problem-solving styles, Lerman says.

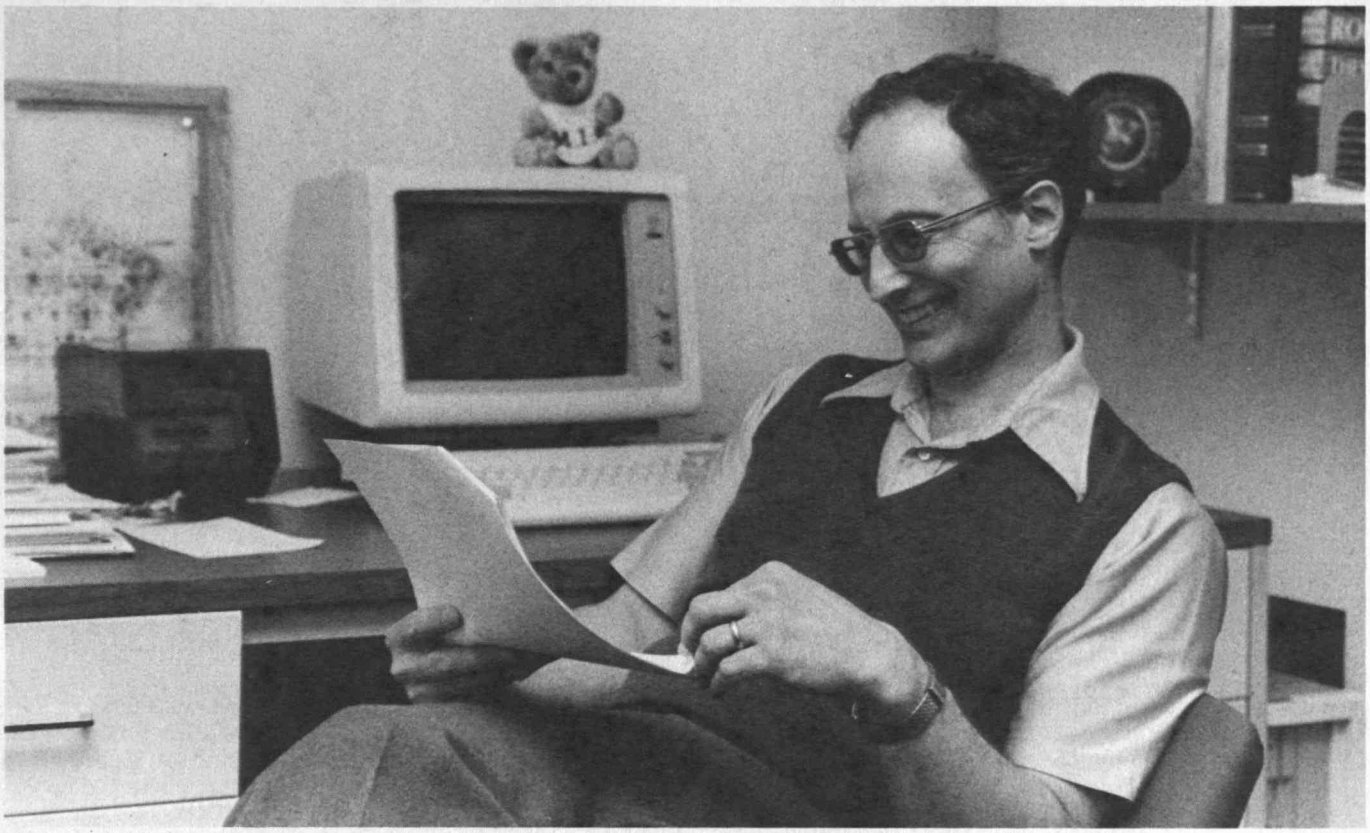
☐ The first common use of the computer is as simulator. As an example, Lerman cited a quantitative physiology class looking at the heart and lung system. At one point, the students face a blackboard with six coupled differential equations. Except for a handful of exceptional students, few will have a gut-level intuitive sense of what happens if you change an element—constrict an artery or administer a drug that increases heart rate. One way to help students develop those intuitions is to give them a software environment that has built into it the method of solving those equations and allows them to explore a series of "what-if" scenarios using different strategies. Such applications are proliferating in fields as diverse as fluid mechanics and macroeconomics.

☐ Another important class of applications comes in the laboratories, where the computer can collect data quickly and continuously. It enables students to collect much more data and handle it more flexibly, and they can compare theoretical outcomes with actual outcomes right on the screen. Athena sponsored a prototype project to build a uniform software system for acquiring laboratory data. The system is now incorporated in 16 work stations, which should go to 30 by the fall of 1985. Students learn to operate the system once and then hook up different instruments. The system becomes an important part of what Lerman calls the "kit of knowledge they carry from lab to lab."

☐ The third use is the computer as tutor. The students generate problems and propose solutions; the computer acts as commentator, offering advice and suggesting ways of looking at the problem and possible sources of error. Implementing computer tutoring is difficult, because there is so much diversity in the information a student can generate.

☐ Fourth is the "virtual laboratory," which Lerman admits is the first cousin of the simulator. The computer offers students an opportunity to explore subject matter that is too expensive, too hazardous, or simply impossible to study in an actual laboratory. Nuclear power stations lend themselves to the virtual laboratory, as do a variety of "Gedanken Experiments" in physics. Many of you will recall the Gedanken Experiment

MAP: NANCY CAHNERS



Jerome Saltzer, '61, is the technical director and system architect for Project Athena. He is in charge of networking 2600 machines stretched from the campus in Cambridge to the fraternities in Boston.

that begins, "A pole vaulter running down the track at .8 the speed of light . . ." from second-semester physics. A real experiment with those premises would be impossible, but the virtual laboratory version could be a powerful teaching tool.

☐ A fifth teaching application relies on computer graphics to rescue students who have difficulty forming and manipulating a three-dimensional model in their mind's eye. By using computer-generated images, the students can understand material in subjects such as crystallography and structural analysis.

The computer is also being used in the classroom as a mediator or referee in "gaming," where it controls the level of communications among students or groups of students who are making decisions in a structured situation on linked work stations. The computer can allow instant communication or none at all, or it can simulate the time lag typical of diplomatic cables. Typically, Lerman noted, students discover that instantaneous transmission of information allows people to defuse situations, while isolation causes escalation of a problem.

Athena is exploring with the M.I.T. libraries what it will mean for students to have access to high-performance computers. It will change the notion of card catalog, for example; students will be able to organize inquiries along many different lines. More fundamentally, the very concept of a library as a place where you go physically to pick up material will change.

Nuts, Bolts, and Circuit Boards

While hardware is not the central focus of Athena, it is important. The student work station, as now conceived, will be a full 32-bit processor, operating at one million instructions per second, having high-resolution monochrome graphics (although the staff is still exploring the trade-offs between a large-screen monochrome display and a small-screen color display). There will be some type of local storage in the form of removable media (streaming tape is the most likely candidate), a connection to a local area network, and a pointing or selecting device such as a mouse.

The second building block of the system is the campuswide network, of which Athena actually will be only one customer. Athena will have as many as 50 or 100 local-area networks, each linked by a gateway to the high-bandwidth, fibre-optic M.I.T. network spine. The gateways can be altered to accommodate a variety of local network technologies and will allow the spine to be upgraded without changing the local networks.

Servers are the third component. File servers and high quality print service will be widespread in the local networks; a centralized name and authentication service will control access and privacy; and a "compute service" will support numerical analysis and databases.

Professor Jermone Saltzer, '61, the technical director and system architect for Athena, describes the project as conservative from a systems-research point of view. His goal has been to minimize the leading-edge technology incorporated in the project except in areas where the educational goals of Athena clearly require it—namely in work stations and networks.

As of May 1985, there were 60 small VAX time-sharing systems around the campus, with 1,600 to 2,000 students using them daily. Athena was in the process of deploying some 160 IBM PC/AT computers, still part of Phase I.

Saltzer predicts that Athena will "dribble in" to Phase II this Fall, as future work stations involving the next

Continued on page A13

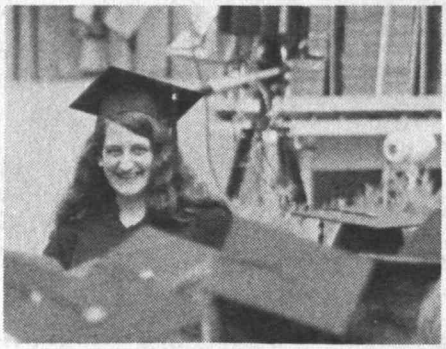
PHOTO: FRANK REVI '86

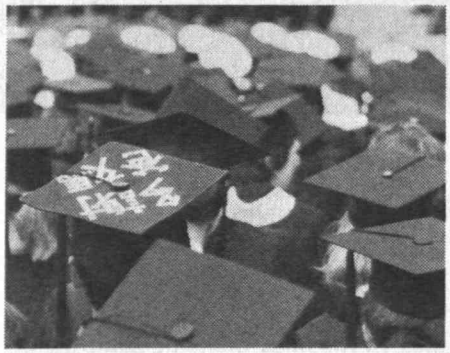
Participatory Pageantry In Killian Court

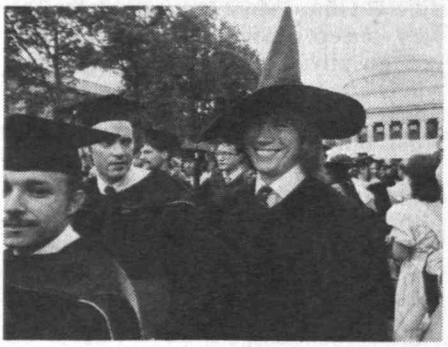
At the freshman picnic two years ago, Harald Reiche, professor of history and classics and housemaster of Baker House, said, "I don't think Sophocles would have approved of this gathering at all, do you?" "Too many people!" he cried. "Too much confusion! No ceremony! No *order*!"

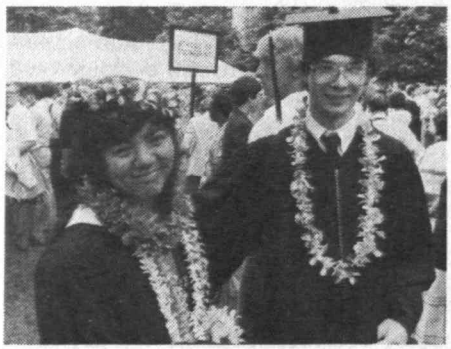
Well, Sophocles would have approved of Commencement. At Commencement the Killian Court enclosure, "a fairy palace with its mighty Pantheon dome, its colonnaded front and broad steps," as Steen Eiler Rasmussen described it in *Experiencing Archicture*, gets the pomp and ceremony that is its due.

Rasmussen said Killian Court "seems to have been created for the sake of that one short pageant [its 1916 inauguration] alone." I prefer to think of it as created for the annual and somewhat magical pageant of Commencement. Magical because it involves the sudden appearance of a small hill, a garden, a reviewing stand, and 6,000 folding chairs in the Great Court. (This only looks magical; actually, Physical Plant works overtime to do it.) Magical because it is the only time apart from presidential inaugurations when the Institute dons the academic costume of *Brideshead Revisited* and the Sorbonne. Magical because families come from all over the world to celebrate together. Magical because there is no rehearsal, yet 1,700 graduates are kept in order and put in the correct one-to-one correspondence with 1,700 degrees. Magical, obviously, because for many of us, it marks the end of our formal studies and the beginning of life after M.I.T.









We Knew When to Break the Rules

When I arrived at du Pont at 9 a.m., it was already choked full of people. At 9:10, they assembled us into lines alphabetically. After four years at M.I.T., we knew when to ignore rules, and promptly reshuffled ourselves into clumps of friends. Half an hour later, Professor John Slater, one of the marshals of the graduates, climbed a two-story high ladder in the middle of du Pont to give us directions. We sorted ourselves back into the registrar's order.

"You've almost made it," said Slater. "All you have to do is follow the person in front of you. The Commencement Committee is one of M.I.T.'s best committee assignments for faculty, but if we lose any of you, they delay our tenure. We will check off your name several times along the way, but please help us."

Be Home In Time For Dinner

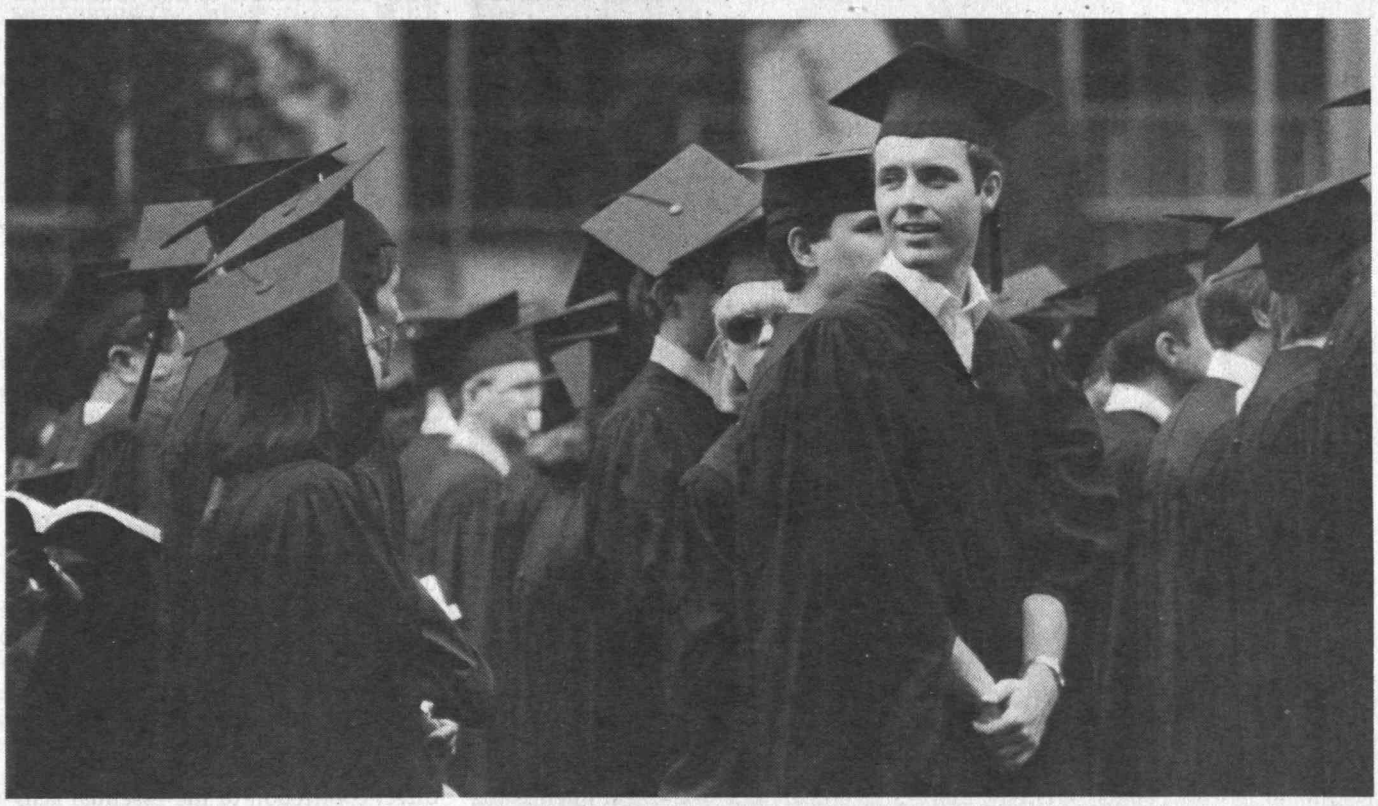
It was the slowest du Pont-to-Killian walk any of us had ever made. Once everyone was seated, there were speeches. Were they better than last year's, or was it just that it was our graduation? (*For President Gray's and Lee Iacocca's addresses, see following pages.*) Rabbi Daniel Shevitz gave a commonsense invocation: "Don't assume that your are indispensible to your project . . . The ethic that puts achievement ahead of loving relationships is a wicked one. Be home in time for dinner."

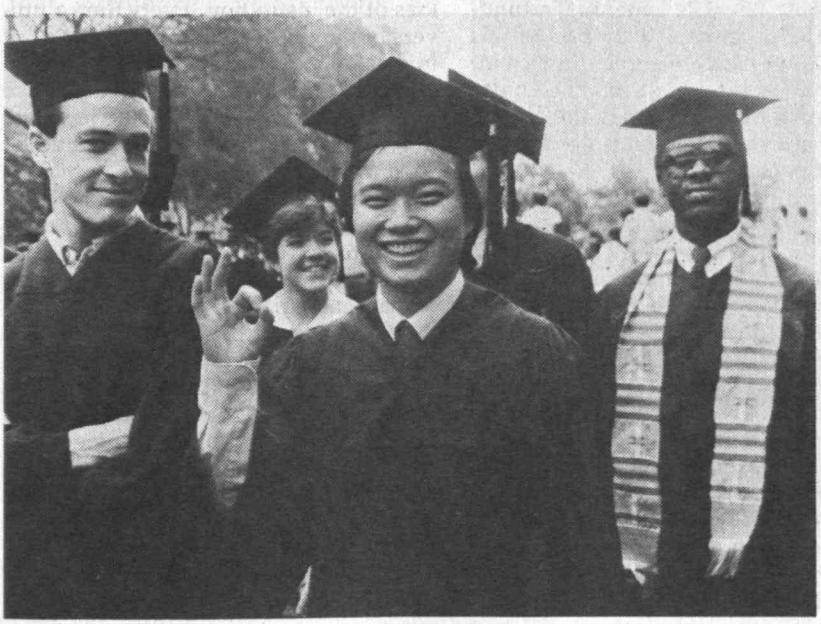
All of a sudden the degree presentation started. First the architects and planners, then the civil and mechanical engineers filed up to Paul Gray and came back carrying red folders and grinning as if they had just been enlightened. Then it was our turn, and it all happened so fast I cannot remember the view from the platform, except Paul Gray shaking my hand and saying "Congratulations."

When we got back to our seats, the whole row of us sat still for a minute just looking at the open diplomas on our laps. We attended to our own private ceremonies: the tassel moved across the mortarboard, the Brass Rat slipped off and turned around. I watched some *Tech* people graduate, and then went to see how my parents were holding up.

Finally the Woods Hole Ph.D.s, the last and most patient of us, collected their degrees and vivid red-blue-and grey hoods. A cheer went up. The recessional began. In no particular order—after all, it didn't matter any more—we started down the aisle toward our waiting families.—*Diana ben-Aaron, '85* □

Diana ben-Aaron (top photo, facing page) and the students pictured on these and subsequent pages experienced a ceremony that is almost the same every year—except this one is their own celebration of achievement.





COMMENCEMENT PHOTOS: FRANK REVI, '86; DONALD M. DAVIDOFF, '86; JIM HARRISON

CHARGE TO THE GRADUATES

Where Is M.I.T.'s Place in the Star Wars Debate?

The following is the charge to the graduates by Paul E. Gray, '54, above left, with David Saxon '41, Chairman of the Corporation.

The *university* is an institution in the middle of the continuing experiment we know as democracy.

For both the university and for democratic society, the common hallmarks are the free and open expression of ideas, the embrace of pluralistic beliefs, the reliance on civil discourse—all in the development of common cause. Just as the university takes its primary direction and priorities from its faculty, so a democratic society draws its strength and mandate from consultation and consensus among its citizens. I would like to speak briefly this morning about the university's role in debates on matters of public interest.

At the university, the principles of open expression and academic freedom have faced challenges over the years—from within and without. We have weathered those challenges and have stood firm against efforts to place limits on inquiry and on open discourse among members of the academic community. As many of you know, the past few years have witnessed some efforts by the federal government to restrict information about university-based research on the ground that—without such restrictions—sensitive technologies may be transferred unintentionally to potential adversaries. These efforts have been much muted in the past year, largely because the university community has been successful in persuading policymakers in the government that science is an enterprise which depends for its vitality and strength on free, open, and widely shared communication and access. And the nation depends on the vitality of science and engineering for continued prosperity, innovation, and economic growth.

We should not assume, however, that concerns regarding the independence of the universities can be put behind us. More recently, two different issues have highlighted the dilemma of the university in the middle.

☐ First, the funding of science research under President Reagan's Strategic Defense Initiative—the program known popularly as "Star Wars"—has created controversy within the scientific and academic communities. We have recently learned that the SDI program will fund basic research in universities, and that the funding of some ongoing research programs which are relevant to SDI may be shifted to that program. The head of the SDI's Office of Innovative Science and Technology has asserted that the participation of university researchers in SDI-funded projects will add prestige and credibility, and will influence the Congress to be more generous in funding for the program. The impact of this manipulative effort to garner implicit institutional endorsement for SDI comes with special force because of the controversial nature and the unresolved public policy aspects of SDI.

☐ Second, there has been a renewal of efforts at colleges and universities around the country—M.I.T. included—to persuade these institutions to take an active stance against the government of South Africa and its system of apartheid. These efforts have primarily taken the form of calls for the universities to sell their stock in U.S. corporations which do business in South Africa. I share the view that apartheid is an evil, unsupportable, and vicious system. I would like to see it end—the sooner the better. Even those of us who decry that system, however, hold differing views as to the consequences of divestment for the majority of the people of that country, for its government, for the corporations involved, and for the universities who hold stock in those companies. And there is a major question, again, of how far a university—chartered for academic purposes—should go in using the resources entrusted to it for the purpose of influencing social policy.

In each of these two cases, efforts are made to nudge the university out of the middle, to put it in a position in which its influence and authority or prestige are used to achieve goals which are only remotely related to the academic purpose or to the vital internal interests of the university.

There Is a Time to Speak Out

Obviously, there are situations in which it is appropriate for a university—for *this* university—to speak with an institutional voice on political issues. Our steadfast opposition to constraints on access to research and on free communication of results, as in the case of technology transfer, is one such example. The test, if you will, is whether the issue at hand has a clear, unambiguous, and direct connection to the essential activities of the institution. Every time a university moves beyond this boundary, it invites political treatment of its own interests, and disenfranchises those within the institution whose views are different. Great caution is required in such matters.

This is not to say the academic community should not participate in the debate on matters of public interest. Questions regarding the establishment of national priorities, policies, and allocation of resources must be informed by the will and the judgment of the people, reflected and expressed within the Congress. The national debate on these issues can—and should—be invigorated and illuminated by discussion and reflection within the universities. Beyond that, universities have a responsibility to communicate these insights to the public and to policymakers alike.

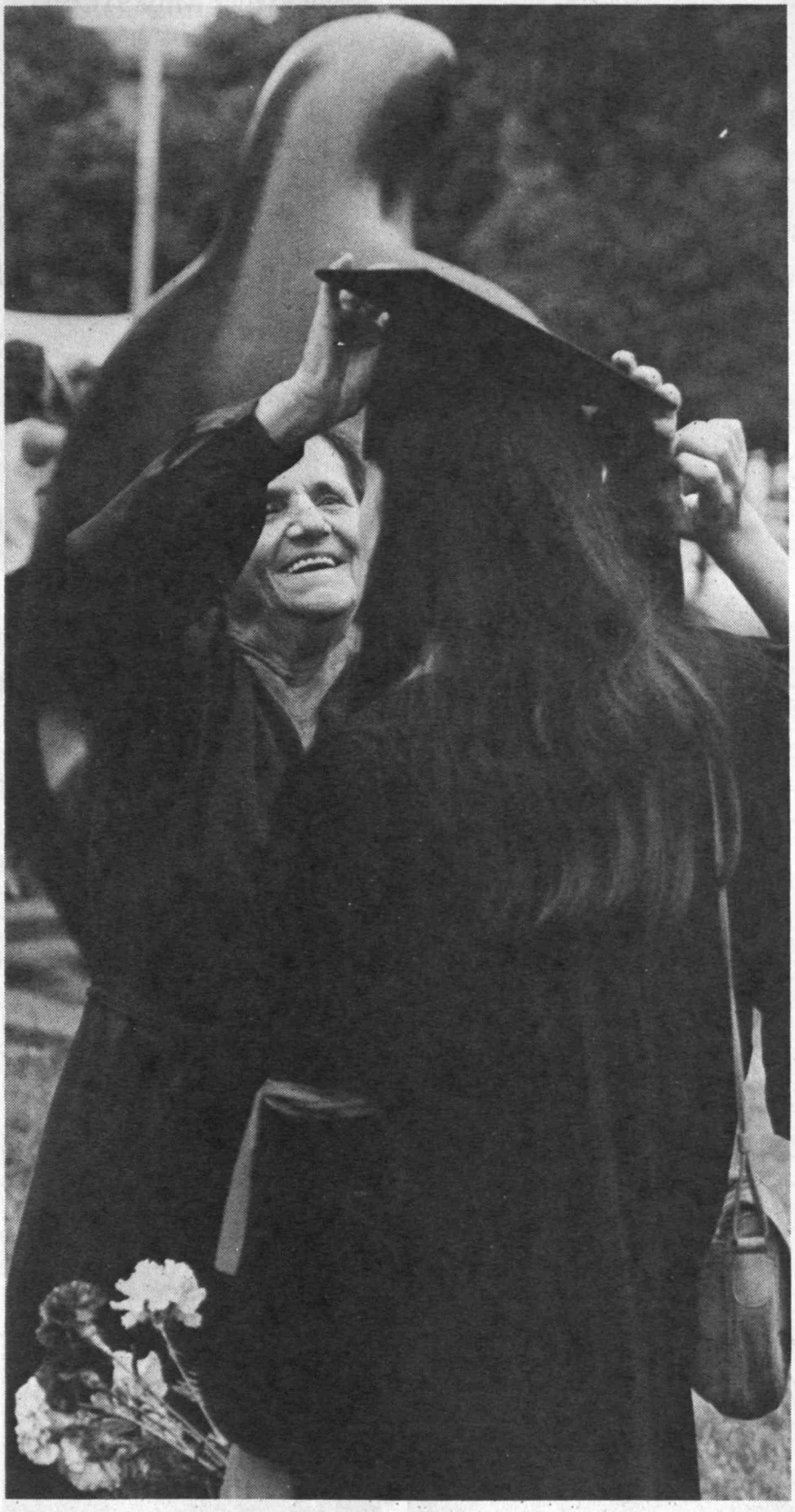
What I find particularly troublesome

about the SDI funding is the effort to short-circuit the debate and use M.I.T. and other universities as political instruments in an attempt to obtain implicit institutional endorsement. This university will not be so used. Any participation at M.I.T. in SDI-funded research should in no way be understood as an institutional endorsement of the SDI program. I have begun communicating this view to appropriate persons in the government, and will continue to do so.

With reference to divestment, it is the policy of the Institute to urge companies in which it invests and which do business in South Africa to comport themselves in ways which improve the status and condition of their South African employees. I believe that this policy is appropriate, both in terms of its effect in that nation, and in terms of the Institute's mission and responsibilities, and I support it fully.

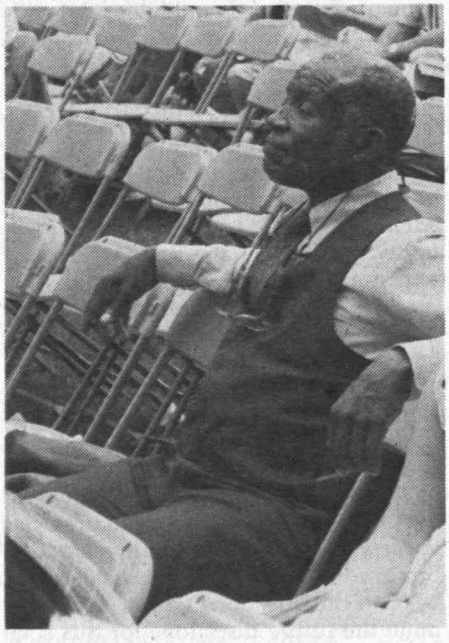
In conclusion, I suggest once again that our continued effectiveness as an educational institution, as a focal point for research and scholarship, and as a place in which the views of all members of the community are afforded the proper respect and credibility, depends on our careful adherence to the principle that, within very broad limits, we should endeavor to be neutral *as an institution* in all matters which do not have a direct and immediate effect on this place. I am convinced that holding fast to the principles of open expression, academic freedom, and institutional neutrality both serves the national interest and manifests our institutional purposes. Our greatest strength is a commitment to the unfettered exploration and discussion of ideas.

Similarly, the free and open expression of ideas, the embrace of pluralistic beliefs, and the reliance on civil discourse to reach our goals are at the heart of the democratic society in which we live. As you leave these halls, I urge you to carry these traditions with you and to bring your voices and your talents to bear on the questions which will determine the future directions for this society and this planet. □



This captures both the maternal pride that is part of every Commencement and the red armbands worn by many graduates to protest Apartheid.

A FAMILY MILESTONE



LEE IACOCCA'S ADDRESS

Ladies and Gentlemen, Start Your Engines

Following is a condensation of the address by Lee A. Iacocca, chairman and chief executive officer of the Crysler Corp., at Graduation Exercises on June 3, 1985.

All in all, if you believe everything you read in the papers, the country must be in terrific shape. The stock market just went over 1300. Companies are spending billions of dollars just buying each other up. And the public is on a buying binge too. They are buying lots of expensive cars and houses. Things are so good even Chrysler made $2.4 billion last year, and we were broke five years ago.

And how about you? Well, you've got the world by the tail. You are all going to make a bundle of money next year at least, and some of you will be Yuppies sooner than you think. We are handing you more than anybody has ever passed on to their kids.

Now, before you get all choked up with gratitude, I should tell you that we haven't paid for all this yet. We are leaving you a mansion, but it's got a little mortgage on it. About $1.7 trillion, in fact, and going to $2 trillion, whatever that is, in just a couple of years.

And if you don't like the deal, if you don't want the mansion, I'm sorry, because it's yours—along with the note. You can't give it back, but you can get mad about it. In fact I hope you do. I am mad too. I think the mortgage you are picking up is a national scandal. Right now we are paying $150 billion a year in interest alone on our national debt. And adding almost $200 billion a year on the principal.

Inflation is a penalty we paid as we went. It took money out of our pockets every day. But these huge deficits are a penalty we are going to leave for you. It is not pay-as-you-go any more. It is more like "pass the plastic." It is a credit card approach, and it is your credit card we are using.

What makes this debt so insidious is that so much of it is invisible. I often say that the government ought to be forced to follow the truth-in-lending law. Every year at tax time, it should have to send you a statement just as your bank does. This year for the average family, that statement would go something like this: "Dear Mr. and Mrs. Taxpayer. This year your family's share of the national debt stands at $27,950. In the past 12 months, your share has increased by $3,980. Your share of the interest bill this year is $2,127. Have a nice day."

Now maybe you noticed that one line is missing from that statement—the one that says, "Please remit." We aren't remitting. We aren't paying our own way.

But there are no free lunches in this life. That bill has to be paid someday, and I guess you get the honor. Unless, by the way, you want to float it long enough to give it to your kids. But I sure hope you don't. The piling up of debt to create the illusion of prosperity is a cruel hoax. And the joke, my young friends, is on you.

Is Anybody Mad Yet?

Now let me pause to ask you, how am I doing so far? Is anybody mad yet? Well, if not, let me tell you about our second national scandal that will put another dark cloud over your futures. I am talking about a trade deficit that is going right off the charts.

Our trade deficit in goods last year was $123 billion. In 1980, we had a $40 billion surplus. So we had a negative swing of $163 billion in less than four years. And we are on a toboggan ride right now. We will probably go $150 billion in the hole this year alone.

These two scandals, of course, are related. The trade imbalance is the bastard child of those huge deficits that raise interest rates and throw the dollar out of whack. The high dollar makes American goods cost more and give foreign products a big leg up.

American companies—I am part of one—can work night and day to be more productive. Three years ago, we built 10 cars per employee per year at Chrysler. Now we build 20 cars per employee per year. But the currency problem just throws all that effort right out the window. Our own fiscal irresponsibility creates that high dollar. We have to fix that ourselves.

But there is another side of the problem. Even when we are competitive, we are facing a crazy festival of trade barriers that keep our products out of other countries. Consider Japan. Last year the Japanese sold us $37 billion worth of products more than we sold them. If you disregard oil imports, 62 percent of our total trade deficit worldwide comes from trade with Japan alone.

The high dollar counts for a lot of that. But so does the fact that Japan protects its own markets. It does so rather openly, without much apology. Japan is a free and solvent nation, and it has a right to act in its own self interest. But, guess what, so do we.

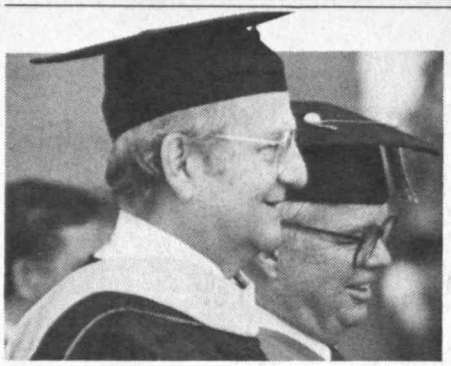
You see, that imbalance isn't just an American problem. It is Japan's problem too. It is a mutual problem because, if it isn't solved soon, your Congress will be forced to take drastic action. The Senate has already fired a shot across their bow by voting 92 to 0 to retaliate because of Japan's closed markets. Now that is pretty significant when you consider that Congress can't even get a unanimous vote to go home for Christmas. So we will probably see a lot of finger pointing for a while, and that could hurt everybody.

We Are Out of Step, Not the Japanese

Now, consenting adults just shouldn't act like that. We should sit down and reason this out. No threats. No talk of trade war. Just an absolutely firm understanding that America has something to protect, too. And that we intend to protect our ability to compete.

But we aren't doing that. Last March we took all import restrictions off of Japanese cars. We said to them, "Look how generous we are. Now what are you going to do for us?" And the Japanese said, "Thank you very much. We are going to send 24 percent more cars in this year than we did last year."

I don't blame the Japanese for a minute. They are very good businessmen. They are managing their trade according



Lee Iacocca (left) and Honorary Chairman of the Corporation Howard W. Johnson, share the stately pace of the academic profession.

to the unwritten rules used by almost every other country in the world. And those rules are simple: devise trade policies that help your own companies compete.

We, on the other hand, are worshipping at the altar of free trade. We are blindly wedded to a set of lofty principles that everybody else in the world ignores. We are the ones who are out of step today, not the Japanese.

Don't get me wrong. I believe in free trade. Who doesn't? I think it is a beautiful ideal. It is right up there with goodness, mercy, and charity for all. But it is not the way the world works. Maybe someday we will achieve that ideal. I really hope so. But I am not willing to risk your futures waiting for that blessed occasion.

Smokestack America Is Dying

One result of these twin scandals may be the deindustrialization of America. In fact, the process is really well underway. Go to Pittsburgh or Akron or Detroit, you will see it all around you. American heavy industry, old smokestack America, is slowly dying. Many of the companies that helped build the industrial middle class, the backbone of the country in this century, are boarded up. Why? They can't compete anymore. They can't compete because our currency and trade policies have tilted the international playing field against them, and they are getting short of breath from running uphill.

Maybe they could use a breather. We got one at Chrysler six years ago with the federal loan guarantees, and it saved us. I suggest some kind of industrial policy to help other companies in trouble. But the purists say it would wreck free enterprise forever. I don't know why.

Chrysler is a bastion of free enterprise today. We are making lots and lots of money. We are paying lots of taxes—a quarter of a billion dollars in 90 days and that ain't bad for guys who were broke. Six hundred thousand people have jobs who would have been on the street if we hadn't survived.

Let me be blunt. Until we fix the currency problem and write a trade policy and an industrial policy for America to compete, it is going to make less and less sense for companies to build plants and put people to work in America. Our trade deficit is already costing us three million jobs, and more are going overseas everyday.

Well, maybe some of you, right about this point, feel that maybe we should deindustrialize America, get rid of all those dirty smokestacks, put everybody to work in service industries, or—maybe even better—high tech. I have to admit that the weather is nicer in Silicon Valley than it is in Detroit. But let me tell you, if America gives up its industrial base there is no future for high tech either, because we smokestack guys are your best customers for all the wizardry that comes from Silicon Valley and from up here on Route 128. We put high-tech to work. We have robots and laser cameras all over the joint now. We have some of the world's finest CAD/CAM facilities. Unless you put high-tech to work, unless you use it to compete, high tech is really just a toy. How much do you think a bag of silicon chips would bring you in a supermarket, anyway?

U.S.A. Reduced to a Colony?

Your future depends on an America that can hook and jab in the international marketplace. And right now America is getting whipped. Our three largest exports to Japan—you have heard this before—are, in this order, corn, soybeans, and coal. Japan's largest exports to us are cars, trucks, and videorecorders.

Raw materials and foodstuffs traded for manufactured goods. Does the pattern sound a little familiar? It is the classic definition of a colony. That is what deindustrialization and weak-kneed trade policies are doing to America. They are making us a colony again.

We were a colony once before. But we got so mad we threw the tea into the harbor—and not very far from where I am standing. Well, here we are becoming a colony again, and I mean that.

And I hope it really makes you mad. Don't burn the place down, or start dumping things into the river here. But get mad. Get mad because some people are saying that you are going to be the first generation of Americans who have to settle for less than their parents had. I hope you don't believe that because it does not have to be true. It doesn't have to be true because, even though we have taken our eye off the ball, your birthright as Americans is to change things.

I Hope You Go to Work Mad

In America when people get mad enough, they can change anything. Righteous anger, intelligently directed, has made this the greatest democracy in the world. I hope every cancer researcher in the country goes to work every morning mad. And every engineer. And every economist even, and teacher, and congressman. Satisfied people change nothing.

Get mad at the people in Washington who are burying you under a dung heap of public debt. Tell them, "No more." Get mad at the ideologues who want to make you martyrs to some 18th century trade principal. Tell them, "No way—we want to compete."

And get mad at anybody who tells you that you have to settle for less. Tell them, "Get the hell out of my way!" You owe that to yourselves.

You, more than most, have been given the tools to meet your own set of challenges. A degree from M.I.T. just about guarantees you at least a shot at molding the future. It is a prestigious ticket, and it puts you right up in front of the pack.

Well, let me tell you, it may also be a bit of a burden to you. People are going to expect more of you. They are expecting you to be leaders and to be winners.

Your M.I.T. degree puts you in the pole position, as they say, and the green flag is about to go up. So now let's see if you are mad enough to make this imperfect world just a little better for your kids. Let's see what you are made of.

So, Class of '85, start your engines. □

The highly visible, much gawked-at Athena cluster in Building 11 was appropriately named the "FishBowl" and for a short time decorated thus.

Continued from page A5

generation of vendor hardware are installed gradually.

The educational enterprise becomes dependent on the system just as soon as it becomes available, he says. "You can measure the level of dependence by the loudness of the screams when something goes wrong, and already we can see that Athena is beginning to affect the fabric of the university."

Athena faces a danger of "ambush from the rear," Saltzer says, because so many students are buying IBM PCs, MacIntoshes, and other computers. They are calling Athena, saying "I've got a computer in my room, and I want to do my homework *here*." This looks to Saltzer like a fairly severe problem. "If we don't provide a smooth path to these machines, we may find that the way has been co-opted. The faculty not already using Athena may start giving assignments for students to do on their home computers. By the time we get there, they may not be interested in what we have to offer."

Saltzer spoke of the more technical aspects of achieving coherence in the Athena system. He sees three forms of coherence, the first of which occurs at the level of operating system. The UNIX 4.2 operating system from Berkeley will be the standard operating system that appears on every work station. It was chosen primarily for its malleability—the Athena staff knows how to tamper with it. But it is not easy to use, so a user-friendly front end for UNIX will be developed in-house.

The second form of coherence Saltzer describes is at the user interface. Saltzer intends that students going through four years at M.I.T. will find that the tools, languages, methods and styles they encounter in their first class using Athena are still being built upon in their last classes. The strategy to accomplish this is not complete, but one approach is clear: force standard software on all users. Athena does this by controlling the purse strings; if it acquires the licenses for a limited number of third-party software packages, it is difficult for a faculty member or student to acquire something different. Not impossible—but difficult. By offering a single editor, single word processor, single data base manager, uniform mail system, standard spread sheet, and a few standard languages (Fortran, Pascal, C and Lisp), Athena will contribute to this form of coherence.

Type two coherence will be further reinforced by a selection of standard tool kits: "If you want a pop-up menu, here's a library routine that provides a pop-up menu; you just provide the words." Athena is also assembling a set of case studies of subjects that have been enhanced through computer applications. Faculty new to the project can benefit from previous developments and absorb accepted operating procedures in the process.

Type three coherence, Saltzer says, is almost a computer-science research goal. He says it would be useful if the output of one application could become the input for another, but it is not essential to M.I.T.'s educational goals.

"How Will We Know If It Works?"

In the end, what are the questions that Athena must answer? The first is to evaluate individual educational projects. Was the concept attainable? Did the project enable students to learn more quickly, more effectively? Was it the most cost-effective way to accomplish the learning? Did anything unintended and unwelcome develop as a result of using computers to reach certain goals?

And the second question is the more global evaluation of Athena as a whole. How much will it cost to extend the project? Do the benefits justify extending it? Who benefits? Are there some students in fact being hurt because they are uncomfortable in a computer-ubiquitous environment? Has Athena influenced the M.I.T. curriculum for the better? Has it influenced the curriculum of other universities?

Lerman warns that difficult decisions must be made, starting with determining who should own the work stations. If M.I.T. goes ahead with something like Athena, can it justify requiring students to buy their own work stations? Expanding and maintaining of the network will be an enormous expense. How will the Institute pay for it? Can the thousands of work stations all over campus be maintained? Then there is turnover: Will Athena be able to update the hardware without changing the software?—*Susan Lewis* □

[Note: This is the first in a series of articles on Project Athena. Alumni who have questions they would like to see addressed in future articles should write to editor Susan Lewis at Technology Review.*]*

PHOTO: JAMES F. BUTLER, '85

For Them, the Lab and Classroom Were Just the Beginning

BY MARJORIE LYON

Every year students work with enthusiasm and skill on endeavors outside the classroom and the laboratory. At the annual Awards Convocation, several dozen of the most dedicated of these students are honored, and this year Technology Review *profiles five:*

David Libby, '85, received a William L. Stewart, Jr. ('23) Award for his contributions to extracurricular life; Ronald Smith, '85, won the Admiral Edward L. Cochrane Award as the male senior showing the highest qualities of humility, leadership, and inspiration in intercollegiate athletics; Chiquita White, '85, received an Albert G. Hill Prize, awarded to minority students who have maintained high academic standards while contributing to the quality of life for minority students; Orin Michels, '85, received the Louis Sudler Prize in the Arts, awarded for exceptional proficiency in the visual or performing arts; and Inge Gedo, '85, received the Laya W. Wiesner Award, given to the undergraduate woman who has most enhanced M.I.T. community life.

Inge Gedo's commentary on the world is delivered in an enthusiastic chirp.

You always wanted to be a doctor? "Yes, but I wanted to be tons of other things at the same time; I wanted to be a doctor, and a lawyer, and a world class figure skater." . . . (She's been in figure skating shows at M.I.T., practicing daily in January.)

Figure skating, soccer, hockey, skiing—"I like to keep relatively fit. I have fun when I play sports, but I'm also competitive."

Long term ideas? "I would love to be an astronaut. I wanted to be a doctor-*cum*-pilot, but the Air Force told me I was too short. I'm about 5'2-1/2". You're supposed to be between 5'4" and 6'4" because of the cockpit. But women and shorter people take G forces better. I think they should redesign the planes. I was kind of bummed."

She is in Air Force ROTC, and for a month in the summer she took survival training, getting up at 5:00 a.m. every morning, absorbing the Air Force ethos. She talks about the jet pilot training, taking over the instruments, being fitting with gear. "It was great; so much power." Even flying the plane in a roll-over maneuver left her unintimidated.

Air Force Second Lieutenant Inge Gedo, '85, with her proud mother and brother.

What happens in September? As of this writing, she doesn't know yet. There is the possibility that the Air Force might use her for intelligence work. The services often send people who like languages for additional language training, she says. She studied French in high school and German at M.I.T., and thinks that exploiting that interest would be "kind of neat."

The Womens Independent Living Group on Mass. Ave. is a key element in Inge's M.I.T. experience. "I wouldn't have lived anywhere else. It really hit me in early February how I was going to miss WILG. We had a work day, when we clean up and fix things. During lunch time we were all in the dining room sitting on the floor. It was so beautiful to see everyone together."

An attitude from M.I.T.? "My attitude has developed and changed. M.I.T. is not structured with fine differences in grades (B+ versus B−) and there is no *cum laude*; everyone is equal. So you really work for what you get, but no one is made to feel better or worse. I think that really had an impact on me. You don't compete against others, you work to know what you want to learn; you compete with yourself."

Ronald E. Smith, '85, is obviously an athlete. Not just that, though. He is calmly self-confident, warm and gentle. His answers are thoughtful and without self-importance, indicating a natural love of challenge.

Why M.I.T.? He wanted to be a marine biologist. In Montana, he hadn't heard anything about M.I.T., but he was attracted by the link to Woods Hole. He received the "M.I.T. Today" pamphlet from the Admissions Office, and it worked.

Lacking a strong high school background, he was also attracted by M.I.T.'s Project Interface—the opportunity to go to a summer program to upgrade his high school education. Math, physics, chemistry, English, and even PE were taken that summer before he began freshman year.

As happens so often, original decisions evolve into something else, and applied biology is the choice Ron made upon arrival. Nutrition and food science became his primary interest.

One of the big things that you do in a small town in Montana is get involved in athletics: for Ron, cross country running, basketball, and track. This led to college sports: varsity cross country, indoor and outdoor track, intramaural basketball.

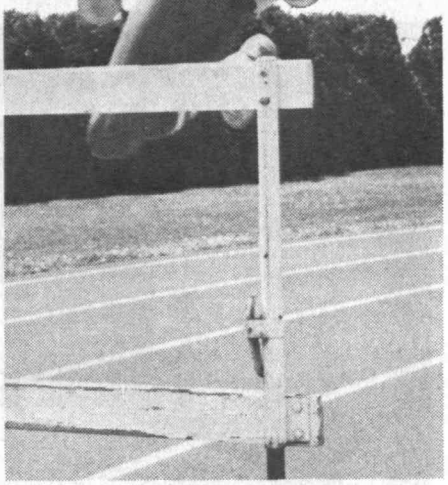
Ron is going to Baylor Medical School in Houston. Did you want to be a doctor since you were two? "No, to me it's more like from God. The thought would come into my mind, and I would put it out, saying no, I don't want to go to medical school. But the idea kept getting

For Ron Smith, the track team was a strong tie to M.I.T.; (below) new graduate Orin Michaels holds an engineering degree but a dream of theater.

stronger. Once I started to look into it in depth, I realized it worked out perfectly with what I wanted to do with my life; I always wanted to help people, and I wanted to use biology and nutrition."

Ron will have long-term obligations to Army ROTC. Each year they pay for school, you owe them one year. That means four years for an undergraduate degree, four years for medical school, plus residency, totalling 13 years of obligation to the military. After this, Ron plans to go seven more. At 47, with retirement benefits, he says he'll be able to set up a practice in a rural area or an inner city, not influenced by income.

The worst of M.I.T.? The constant pressure. "During all the breaks you could do an infinite amount of studying. (He laughs) But it would be like that anyway, because when I went to Oregon State (on the M.I.T. domestic year abroad), I just took more courses. If it's too easy, then you think you're wasting your money."



Orin Michels, '85, talks fast, with flip humor, but serious plans. He knows exactly what he wants and it's not what one would expect from an electrical engineer.

Penn State is in a town where students (40,000) outnumber permanent residents (about 35,000). That is where Orin grew up. Since everyone he played with had professors for parents, education was highly regarded. And the facilities were available; by the time Orin was in high school he had attended stage lighting and design courses at Penn State and worked as a technician for rock concerts.

He jumped into Tech Show freshman year, but was disappointed that theater at M.I.T. is an amateur endeavor. By the end of sophomore year, though, his sister at Harvard had provided an opening there, and he worked on ten shows. "I found that when I'm working really hard on theater I would do better studying. When you're working all the time like that, every spare moment is used wisely. And the adrenaline level is up. For seven consecutive weeks I was doing show production; I would have a show opening the same night I was hanging lights for a different one."

One summer Orin worked for Harvard-Radcliffe summer theater, as technical director and lighting designer. Last summer he returned as technical director and set lighting designer for the community theater where he used to be an apprentice. "That was a job—I was actually getting paid real money to do theater, which beats working for a living," he says.

"I've wanted for four years to start a theater group here. I'm convinced that we have the talent. I wanted to prove that to someone, if only to myself."

Junior year, Orin and Matte Kaplan, '77, put on "Pippin" in Baker House dining hall. "We got a $250 grant from Council for the Arts, some money from the house, and I put in some cash." In only four and a half weeks, with two days notice before auditions, they cast 25 people from Baker House. The script arrived by Federal Express, and rehearsals were every night.

Orin's idea of the future has evolved: originally he planned to try to make it as a designer and still be able to eat by working as an engineer; now he believes that being a producer full time is not impossible.

"Right now I'm going to LA to work in engineering for Hughes Aircraft. I sort of told them I don't want to be an engineer and they made me an offer anyway. I thought about starting the Hughes Reportory Company."

Why M.I.T.? "I was 'Joe Math and Science.' I was supposed to go to M.I.T., so I did. If I had to do it again, I don't know if I would. But I do have quite a sense of accomplishment, and I feel really proud.

"My GPA is horrible, but I've gotten everything out of M.I.T. that I wanted to. I can hold my own as an engineer, and I've also learned a lot about doing theater, doing 25 shows since I got here. I don't even know if I would have done that many if I'd gone to a real (theater) school." *Continued on page A16*

PHOTOS: PEGGY KUTCHER, FRANK REVI, '86

Chiquita White, '85, is joyful. Talking fast, eyes sparkling, radiating energy, her aliveness is a palpable force. A quick, generous smile turns into easy laughter.

When she came to M.I.T., she wanted to go to medical school. "But I enjoyed the whole chemical engineering attitude," she says. "It is a very diverse field and touches a lot of different things. I could go into the semiconductor industry on Monday, and then after a year if I didn't like that I could work on consumer products. I thought I could touch a lot more lives by working in chemical engineering." Next year she will do graduate work at the University of Pennsylvania in chemical engineering, she regards the year as a test of her enthusiasm for the field.

The University of Pennsylvania ties into her future plans in many ways. She is very active in Alpha Kappa Alpha (AKA, a national sorority founded at Howard University in 1908), and there is a high-powered chapter in Philadelphia, she says.

Last year, because she had the highest GPA in her region (Maine to Washington), Chiquita won a two-week trip to Paris from the sorority. This year she won Miss AKA for the region, a title awarded to the person who most exemplifies the purpose of AKA.

Chiquita went to classes and did her homework, but the memorable part of M.I.T. for her is extracurricular activities. The Black Student Union and the National Society of Black Engineers attracted her. She was heavily involved in student government, worked on committees in the Dean's Office, such as the council for admissions and financial aid, and coordinated minority students' spring weekend as well as a program for the Office of Minority Education. "I find I'm studying most when I have a lot of other things to do," she says.

"After my freshman year, working up here for the summer, I got to know Boston, and I got to know some people. It was so much fun. After that summer people couldn't drag me away from here."

(Top) Chiquita White; and David Libby.

David Libby, '85, arrived at M.I.T., from Woodland, Maine, the second student ever to enter the Institute from this papermill town on the Canadian border. "In eighth grade I became interested in computers. I decided then to major in computer science at M.I.T." When he arrived here, he brought with him an interest in politics and student government that grew in high school.

He started out with a major in computer science. "That was fun; it kept me up late at night, but was interesting. Then I took a lab course, and hated it. I wanted something where I could help people more directly. So I switched to Urban Studies and Planning to major in public policy."

Now he may be headed in a slightly different direction. "I started looking at jobs in public agencies, and found you work with people directly, but only a limited number, in your agency." So his interest has turned to administration of higher education, which offers an avenue for helping a lot of people and it has a tinge of public policy. Through working closely with the Dean's Office as Undergraduate Association president, David had a lot of background in this area.

"One thing I have gained from my experience in student government: I used to be a very patient person and I have less respect for patience now. Patience at the Institute level may mean that something takes 10 or 20 years to get done. The pople who move things are the impatient who say 'Why?' "

Was M.I.T. what he had imagined from eighth grade? "Yes, and a lot more. So many things to do, you can't do more than 10 percent of them. Academics is one of those things; it's very important, why you pay to come here, but it's not everything. I'm more confident now in being involved in non-academic things."

These activities took up much more time this term; David will graduate in September, spending the summer working on his thesis. Some things came up that had to be done, he says; school could wait and they couldn't.

"There is a perverse kind of school spirit here; people go around with their IHTFP tee shirts. It's rough academically, so people need to blow off steam. So they have this abstract thing called M.I.T. to complain about. Most of the individuals or professors they know, they like very much," he says.

Given that he is a no longer majoring in computer science, was M.I.T. a right choice? "If I had been interested in public policy in high school, and applied to colleges on that basis, I probably would not even have applied here, just because M.I.T. is so much science. In retrospect, I think this is the best place I could have come. The programs here are very good. I have received a much broader education by going into social science at M.I.T.

"People who get involved in activities here don't really do it for their resumes. They get involved because they want to, and that makes it much nicer to work with people. It is an honest place."

MARJORIE LYON is a freelance writer and former editor of Technology Review.

13

Not much news for several months. I should have acknowledged a couple of notes for the previous issue, but early in February I caught a bad case of the flu and didn't do anything constructive for six weeks. Now that the nice weather is here again, I am getting back to normal and trying to catch up on some projects.

Received a card in December depicting **Walter Muther** about to dive into a swimming pool. It also stated that Walter, his daughter Sally and family are all swimming regularly at least three times a week at the Y.M.C.A. Walter says, "Great for what ails us." I agree.

Allen Brewer wrote that his dear wife, Maurine, passed away August 30, 1984 from a cardiopulmonary attack. He continues: "So I'm lonely; living at home with memories. However, I still write poetry, but now in a more serious vein. . . . Over Thanksgiving, I flew to Fort Worth, Tex., for a few days with my eldest granddaughter, then on to Palmdale, Calif., for a few days visit with another granddaughter. My progeny seems to thrive wherever they are. Closest right now is grandson Gordon who has built a home at Rocky Point about half an hour from me, near Salerno. Right now, plans are nil. Just day by day. But son Gordon says he will wheel me to the '88 reunion, come hell or high water. I'm strong on faith these days, so let's keep our fingers crossed."

We are advised by the Alumni Office that **Warren A. Gentner** died in October, 1984. Also from the Alumni Office, a notification that in July, 1984, Dr. **C. Lalor Burdick** received The Marshall Medal of the Society for the Study of Fertility in Great Britain. He was honored at the annual meeting in 1984 held at the University of Reading (England), for continuing support of research in reproduction.

Until the next time we have more news.—**Rosalind R. Capen**, Acting Secretary, 7 Brackett Point Rd., Biddeford, ME 04005

14

From his daughter, Deborah Chatfield, and his cousin, Mrs. H. Norton Sudduth, we receive word that **Charles H. "Dinny" Chatfield,** died May 12, 1985. He was active as 1914 class secretary since 1971 and did a wonderful job keeping this column going. We will surely miss him.

After receiving a master's degree from M.I.T. in 1915, Mr. Chatfield was on aeronautical inspection and engineering duty in the U.S. Naval Reserve Force and was one of of the officers first assigned to the Bureau of Aeronautics in Washington at its inception. In the twenties he was in charge of airplane design projects at Wright Aeronautical Corp. in Paterson, N.J. In 1926 he became an associate professor of aeronautics at M.I.T. and during his three years here was co-author of *The Airplane and Its Engine*. In 1929 he joined the engineering staff of a predecessor of United Technologies Corp., and in 1941 was elected secretary of the corporation, an office he held until shortly before his retirement in 1960. He was a member of several engineering societies and community organizations.—*ed.*

15

I have received a letter from **Francis Hann**, a regular correspondent, who mentioned he will be 93 on Pearl Harbor Day, and feels mighty fine.

After writing to **Robert Warren** for more than ten years like all the '15ers, I hit the jackpot and received a four-page letter from him. He has some ideas for the '15ers which I will bring up in my next column. I intend to call him over the weekend, and we will then "break the ice" together—just like a soap opera. . . . to be continued in October! Come on, please, I want to hit more jackpots!

Now for my "old faithful," **Loring Hall**. He advised me he is busily working on the company history, which he has been asked to do, and had been in touch with **Otto Hilbert** to get some ideas from him as Otto has been working on the Corning Glass history—both very busy gentlemen!

Loring has also been working on a program to get the money from criminals for the much-needed new prisons, not law-abiding citizens and taxpayers. Recently State Senator Cruse introduced such a bill.

Loring reminds me of my own self. He has three desks and they are piled up with correspondence and "work in progress."

As always he works hard in the garden, mostly with perennials, and likes to divide them to make more every year. He has 25 different varieties and all but one carried through our severe winter.

Now we will look back at his Junior Year at M.I.T., which I am certain will bring back memories to each one of the Class Supreme:

September 26, 1913: Went to Rogers Building to register for my Junior year. I hope it will be as interesting as the first two. The three freshmen who were assigned to me last summer were there. They are Alfred Pierce, Oscar Peterson and E.A. Polley, of the Class of 1917. I liked them all and enjoyed getting them off to a good start.

September 27, 1913: At Brockton, Mass., worked all day with Rube Bassett. We each had a horse and wagon and delivered the aluminum cooking utensils we sold early last summer. Brought home about $200.

September 29, 1913: The work at M.I.T. started this morning at full speed. Had railroad engineering with Prof. Allen. The subject was a test on deflection angles. Next was applied geometry and then electrical engineering. I missed out on the geology lecture. Had dinner with Sam Fox at 16 Exeter St.

October 1, 1913: Had four long hours of railroad drawing this morning and after lunch three hours of surveying. In the evening went with Milliken, Ober and Fox to see Julia Sanderson in "The Sunshine Girl." She was good and so was the comedian, Cawthorne.

October 4, 1913: Had geology and "Triple E" this morning. Took a walk in the evening to practice my talk for the public speaking class on Monday.

October 6, 1913: My talk this morning was about the saw mill that Dick Hefler and I went through in Maine last summer. I was criticized for nervousness and the gloomy look on my face, but was commended for my voice, although it broke once or twice. I don't find it easy to speak to an audience.

October 8, 1913: Put in seven straight hours of drafting. Finished my "Stadia Reduction Plot" in advanced surveying. Sent to Hartford for "The Lithology of Conn." Enclosed a money order for 48 cents.

October 20, 1913: More speeches at #6 Lowell Bldg. This time five of us had to give dissertations on the advantages of small schools over large. After an "EEE" lecture by Prof. "Hot-Wire" Smith I came home and studied.

October 21, 1913: In political economy this morning we had an interesting discussion on the subject, "Should the daughter of a rich man work for a living?" Went to see Walter Kerth, general manager of "Tech Show 1914" to apply for the job of business manager.

October 21, 1913: Junior Class elections held today. The results **Frank Scully**, president; **Ralph Fletcher**, vice-president; **Mary Plummer**, secretary; and **Wardwell**, treasurer. I lost out to **Mary Plummer** for secretary. Worked in the physics lab until five o'clock.

October 30, 1913: Went to lithology lecture at ten. In the public speaking class I gave my memorized speech "The Durable Satisfaction of Life" by Dr. Eliot. It was well received. Cut Spanish so I could do some shopping at Jordan Marsh's.

November 13, 1913: At four o'clock there was a meeting of the Civil Engineering Society. Mr. J.N. Ferguson, M.I.T. '94, gave an illustrated lecture about the construction of the Commonwealth Docks in South Boston. His presentation wasn't very good. As treasurer I had to collect the dues and give out some "shingles."

November 14, 1913: Spent an hour with Prof. Robinson, practicing my speech. He was very patient and helpful. The rest of the day I worked on the contours of my railroad drawing. Wore my new brown hat today.

November 17, 1913: Had a railroad exam this morning on which I didn't do very well. Made too many boners. In the Physics Heat Lamp the experiment was "latent heat." Had too many mishaps and mistakes. Was late to the geology lecture. Not a very good day!

December 4, 1913: A lithology lecture this morning by Mr. McKenzie. After Spanish I came home and worked hard on applied mechanics and physics until midnight. They sure are tightening the screws on us now.

December 11, 1913: Performed experiments on a 1 HP Holtzer-Cabot motor with Bibolinni and **Gallagher**. It was very interesting.

December 12, 1913: Went with other members of the C.E. Society to the Berger Instrument Factory in Roxbury. We saw how levels and transits are made. It gave us all a greater respect for the instruments we handle in our work.

Enjoy the fine and beautiful fall weather and please "tune in" to see what we have to offer,

come October. Also, please write!—**Joyce Brado**, Acting Secretary, 491 Davison Rd., Apt. 9, Lockport, NY 14094

16

Dinah Coleman

Caruthers A. "Dinah" Coleman was recently honored by the New Mexico Military Institute. He writes, "It all started because the New Mexico Military Institute (NMMI) Alumni Association discovered that I was their oldest living graduate. They invited me to their May graduation exercises as a guest of the Institute. To make the trip worthwhile, I flew first to El Paso, where my family had lived for three years to overcome pulmonary problems. El Paso has grown from 20,000 in 1910 to 600,000 today. Ciudad Juarez has grown from 5,000 to 1 million, due to the location of many American industries.

"From there I flew to Durango, Colo., spending the night at the Strater Hotel, a victorian hosterly kept in the old manner. The next day I took the Durango Silverton train, a narrow-gauge steam-driven operation, to Silverton. Then I flew to Roswell, N.M. where I was met and taken in charge by Captain Keith Gibson. First we toured the grounds of the Institute. The enrollment has grown from 150 to 750 with a calvary troop as part of the cadet corps. The buildings and grounds have grown in proportion. I reviewed the troops with the general in his jeep and the only woman general in the army. I was wined and dined for two days and had the pleasure of sitting next to Mrs. Otero, secretary of the treasury. During the day I was inducted into the NMMI Hall of Fame, The next day was graduation. Mrs. Otero gave the commencent address, and the lady general inducted about 100 of the graduating cadets into the army as second lieutenants. That night at the final ball I danced a few steps with a gorgeous lady who was the secretary's personal agent.

"Next day I flew to Albuquerque; the growth of that place is fantastic, due no doubt to the location of the Sandia complex. Thence home the next day. Believe it or not, during the eight days I rode on nine airplanes, a form of transportation that I do not really like."

Keep the letters coming. And, as always, keep eating, drinking, walking, breathing—everything in moderation.—**Bob O'Brien**, Acting Secretary, H.E. Fletcher Co., Groton Rd., W. Chelmsford, MA 01863

18

Yesterday—Sunday, May 12—was a joyous occasion. It was the spring meeting of the Cardinal and Gray Society at Endicott House. The grounds of this estate were never more beautiful and spectacular. Class of '18 was represented by Selma and myself together with Eleanor Kilduff. The featured speaker was the retiring M.I.T. Alumni Association president, Mary Frances Wagley, who told us of women's contributions and challenges at M.I.T. Our class feels very close to the Cardinal and Gray Society, whose beginnings date to our earlier reunions at Endicott House.

We are indebted to Ida Mae Kennard for her review of some of the activities of Jack's career, whose death was reported in the preceding *Review*. She writes from Jamesburg, N.J. : "He thoroughly enjoyed being a member of AT&T Bell Laboratories for 42 years. He became assistant director of outside plant development and retired October 2, 1962. His hobbies were golf and fishing—fly-casting for trout and salmon in Maine and Canada. He was also tremendously interested in the solar system and the exploration of space and kept people in the libraries busy trying to find reading material for him."

Thanks to Fran Donovan for this note to us about **Harold Weber**: "When we visited Marian Weber last week, she showed us a letter from the White House which she had received recently. It carried the great seal in gold, was signed personally by Ronald Reagan, and read as follows. 'The United States of America honors the memory of Harold C. Weber. This certificate is awarded by a grateful nation in recognition of devoted and selfless consecration to the service of our country in the Armed Forces of of the United States. President of the United States.' "

Several weeks ago I stopped for lunch at the University Club in Boston. I was one of a group of about nine at a round table. We finally dwindled to two. It turned out the other one was Dick Wills—son of Bill. We enjoyed an extra 15 minutes talking about Bill. Dick is following his father's footsteps.

A note from the Alumni Association tells of the death of **James W. O'Brien** in Clearwater, Fla. in June 1975. No other details.—**Max Seltzer**, Secretary, 1443 Beacon St., Brookline, MA 02146; **Leonard Levine**, Assistant Secretary, 599 Washington St., Apt. 15, Brookline, MA 02146

19

In talking with our 1919 classmates, one topic sure to arise is our advanced ages. However, despite age all we've heard from recently are mentally alert, enjoying life, and taking part in it, usually with zest. **Don Way**, our class president has reading problems, which he solves by using electronic books that he can read with his ears. Such a book referred to the quantum theory, so I wrote him a few lines about Planck's constant. If these terms are strange to you, you too might enjoy reading up on it. . . . Had a most enjoyable talk with **Tim Shea** reviewing the Institute then and now. Tim is enjoying his family and his grandchildren and was about to visit his sister in Newton. He will shortly celebrate his 87th birthday.

Not hearing from **Leo Kelley** for several years, we called him at his home in Texas. Due to time zones, he was still in bed and will call me back later. We felt better. . . . Received a long letter from **Doc Flynn**. On the phone his hearing aid acted up, which made two of us, but his letter confirms he is doing quite well. . . . Found **Alan McIntosh** at home and glad for a call. He continues active and glad to hear of other classmates. . . . Your secretary enjoyed a celebration of his 90th birthday on Easter Sunday with over 30 direct and indirect family persons present, including a niece from San Francisco and a niece from Toronto.

Hope these notes find you well and enjoying a pleasant summer. Would like to receive a few lines from you.—**W.O. Langille**, Secretary, Box 144, Gladstone, NJ 07934

20

Irv Wilson of 50 Center Village, Lynnfield, Mass. says that he maintains a fairly active schedule with the help of three children, 13 grandchildren, and 15 great-grandchildren. He is looking forward to celebrating his 65th wedding anniversary on July 3. . . . Word comes of **Joel A. Goldthwait**'s death in February. He lived at Longacre Farm, Medfield, Mass. . . . A gracious note from Vera Howes, Homer's widow, says she expects to make a tour of Italy this summer with friends interested in music. It was good to know she remains in good health. Like Homer, she has been a staunch supporter of the Class of 1920.

A bit too early to report on the 65th, but I anticipate reasonable success and shall provide the details in the next issue.—**Harold Bugbee**, Secretary, 702 Country Club Heights, Woburn, MA 01801

21

The M.I.T. Club of Northern New Jersey held its 50th anniversary dinner on May 15 at the Suburban Country Club in Union, N.J. Your secretary remembers well the founding dinner held at the Newark Athletic Club in 1935 with M.I.T. President Karl T. Compton as the featured speaker. Three members of our class have been presidents of the club: **Carole A. Clarke, George Chutter,** and **Sumner Hayward**. The club's longtime treasurer and ex-officio membership chairman was **Joseph Wenick**, who did a marvelous job keeping the club active. The May 15 meeting featured a talk on the Edison Papers by their curator Reese Jenkins. **Cac Clark** introduced the past presidents of the club that were present and gave an excellent brief history of the founding of the club.

I learned in a telephone conversation with Claudia and **Josh Crosby** that following the ministrokes that Josh had last year he had lost quite a bit of weight and had limited his daily walks to a short distance around the block. The Crosbys are not going north this summer to their cottage in Brooklin, Me. Josh reported that they had not seen or played bridge with Millie and **Herb Kaufmann** for some time.

An Alumni Fund envelope brought in a note from Dr. **Kenneth Bates** that he was in excellent health and still active. He adds, "My greatest joy are my four living children, 11 grandchildren, and six great-grandchildren."

Two deaths have been reported this month: **Edward I. Mandell,** Miami, Fla. (date not known) and **Alfred H. Fletcher,** Newtown, Pa. on November 8, 1984. Our sympathy is extended to their families.—**Sumner Hayward,** Secretary, Wellspring House E64, Wash. Ave. Ext., Albany, NY 11203; **Josiah D. Crosby,** Assistant Secretary, 3310 Sheffield Cir., Sarasota, FL 33579; **Samuel E. Lunden,** Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22

The office of the Mayor of Seattle on April 20, 1985 issued the following proclamation: "Whereas, **H.W. McCurdy** is descended from some of our state's earliest settlers: and whereas, H.W. McCurdy, over his long life, has been one of the city's most influential citizens; and whereas, H.W. McCurdy, as long-time president and chief executive of Puget Sound Bridge and Dredging Co., built and repaired hundreds of ships, dredged dozens of waterways, built hundreds of structures including our first floating bridge, and was instrumental in building naval airfields in Alaska, the DEW line and other construction that helped keep America safe and free; and whereas, H.W. McCurdy, as an octogenarian, continues to generate great interest in the history and the future of our city and the Northwest; and whereas, H.W. McCurdy's abiding support of our Historical Museum is evidenced in its improved image and increased budget; now, therefore, I, Charles Royer, Mayor of the City of Seattle, do hereby proclaim April 20, 1985, H.W. (MAC) McCurdy Day to celebrate all he has contributed to Seattle's heritage. Charles Royer, Mayor." Mac, again our compliments to you.

Last March, the Spalding Inn Club in Whitefield, N.H., successfully run by **Randall E. Spalding** and his family for 59 years, was sold to local

New Hampshire residents. Those of us who attended our 55th Reunion remember with pleasure our stay at Bunt's establishment. In the May, 1985 issue of the Spalding Inn & Club News is a fine picture of Randall and wife Anna sitting in their Model T roadster in front of the Inn many years ago.

Spencer H. Lane, Course VI, died earlier this year in Saint Paul, Minn. No details are available. **Seward W. Livermore**, Course XV, whose last address was in Washington, D.C. also died this year. Again, no details available. **Joseph M. Cosgrove**, last of Inverness, Ill. died last February. He had been an electrochemical engineer with Amphenol-Borg Corp., Broadview, Ill. He generously left a bequest to M.I.T. He is survived by a son, Clarence E. Cosgrove. **Arthur H. Fischer**, Course V, died December 3, 1984. Art, who entered as a sophomore from Rhode Island State College played the piano in the M.I.T. and Tech Show orchestras. He lived in New York City where he had been president and director of Miner EC Corp., 120 Broadway. Survivors unknown.—**Yardley Chittick**, Secretary, Box 390, Ossipee, NH 03864

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Royal Sterling writes that our executive board has voted to elect Phyllis Davenport, Conchita Pearson, Isabelle Skinner, and Mary Sterling to honorary membership in our class. We hope to welcome these new honorary members at our 65th reunion in 1988. Mary has recently had an implant to correct a cataract. According to Royal everything went well. . . . **Al Pyle** has presented the University of Delaware with three steam models he built of a steam dredge, a steam railroad, and a steamboat designed by the 18th century Delaware inventor, Oliver Evans. A reception honoring the gift was held on March 23 in Robert L. Spencer Laboratory at which Al gave a talk which went so well that the head of the mechanical engineering department invited him to become an adjunct professor.

Robert Kean died on January 16, 1985. He graduated with our class in chemical engineering practice and took his S.M. in 1924. He took his Ph.D. in physical chemistry at the University of Virginia in 1938. From 1926 to 1928 he was an instructor in the chemical engineering department at the Institute, then was assistant chemical director of the National Lime Association, Washington, D.C. for a year, and was with the International Filter Co., Chicago as a research chemist from 1927 to 1931. He was a research fellow at the University of Virginia from 1932 to 1938. He joined Virginia Carolina Chemical Corp. in 1938 and was successively director, chemical division, assistant director of research, research division, and director of development. Until retirement in 1965, he was a consultant with the company. During these latter years he was also research associate, Department of Chemistry, University of Virginia. He was a trustee, Virginia Institute for Science 1936-63; recipient of Distinguished Service Awards, Virginia Section, American Chemical Society, 1957; a registered chemical engineer in Virginia; fellow, American Institute of Chemists; member, American Institute of Chemical Engineers; member, American Chemical Society, Virginia Academy of Sciences, the American Academy of Arts and Sciences, and Sigma Xi.

Alan R. Allen died sometime in March 1985. He graduated with our class in physics and took an S.M. degree at Harvard. After graduation he joined the Kennedy-Van Saun Manufacturing and Engineering Corp. of New York as sales executive and erection manager of large industrial plants throughout the world. He retired in 1963. He had for many years recorded class activities in motion pictures which now are in the M.I.T. Museum. He was a life member of the American Society of Mechanical Engineers, a professional engineer in New York state, a life member of the Masonic Lodge, Tokyo, Japan, 32nd degree Mason, and the Shriners of New York.

Oswin Lowry died on February 12, 1985. He received a B.S. degree from Northwestern University in 1921 and graduated with our class in mechanical engineering. He began his career as an industrial engineer and a production manager in furniture. He was co-founder and vice-president of Charles R. Sligh Co. of Holland, Mich., later becoming president of the Sligh-Lowry Furniture Co. in 1958 which merged with the Charles R. Sligh Co. until his retirement in 1968. He was secretary of the Chicago M.I.T. Club in 1925-26, Rotary Club, Macatawa Grand Rapids, Country Club of Florida, Ocean Club of Florida at Delray Beach, and University Club of Grand Rapids. Past president of Holland United Fund and vice-president and director of Michigan United Fund. He served in World War I as second lieutenant in the infantry. His hobbies were trout fishing, bird hunting, golf, tennnis, and sailing. He was chairman of the Lake Macatawa Water Pollution Abatement Commission, a group of volunteers who were dedicated to reducing pollution in Lake Macatawa and Lake Michigan.—**Richard A. Frazier**, Secretary-Treasurer, 7 Summit Ave., Winchester, MA 01890

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A note from **Phil Blanchard** reports that he and **Clint Conway** were living at the Lakeview Terrace Christian Retirement Center, Altoona, Fla., when Clint died on April 11, 1985. Phil was asked to deliver a eulogy at the Center Services, and mentioned the many activities they had enjoyed together. Phil and Besse have returned to Woodbridge, Conn.

A letter to **Don Moore** from **Rock Hereford** apologizes for the breakdown of his car, up to the mile-high MIRA Observatory with Astronomy Prof. Sandra Faber, Don's daughter. Rock has completed his book, *A Whole Man and A Half Century*—36 ring-binders of research notes and years of searching all over the country. He expects to mail fliers, soon, with the hope that libraries and bookstores will evoke a material interest. The beautiful California weather has inspired him to hike twice weekly to 1,000 or 1,500 feet. He thoroughly enjoyed our 60th Reunion.

We are advised by Clifford F. Crouse, president of Frazier-Simplex, Inc., Washington, Penn., that Dr. **John Earl Frazier** passed away January 1, 1985 in a Washington hospital. He was awarded an S.M. in chemical engineering following a B.S. from Washington & Jefferson college in 1922. After two years with Owens-Illinois, Inc., he joined Simplex Engineering Co., as a fuel engineer, advancing to secretary-treasurer until 1938 and then vice-president and in 1949 became president and chairman. He had wide interests through societies and clubs, being a director of many including banking, ceramics, photography, dogs and civic organizations.

B. Richard Headstrom died of cancer February 8, 1985 in Aiken, S.C. He attended Harvard and took courses in material sciences at M.I.T., specializing in biology. He was honored on the *Aiken Standard* editorial page as a distinguished citizen leaving as an impressive monument his 22 books about nature. His first book was published by Princeton University Press when he was only 19. His recent works were *Suburban Wildlife* and *Suburban Wildflowers*. His latest, on rocks and minerals is at the printers, as well as his final book relating to his 60 years as a naturalist.

A solicitor's report indicates that Col. **Edison A. Lynn** died in 1985 in Dahlonega, Ga. Nothing is known of his career, but as an army man, he probably had many addresses.

We have a note from a Dorothy Conley advising that Mrs. Osborne Davol passed away December 14, 1984, presumably in Birmingham, Miss. **"Dippy" Davol** died July 12, 1980.

At lunch on May 9th with **Don Moore**, **Ray Lehrer** and **Herb Stewart**, we listened to a few recent European experiences of Herb. Wanting to avoid the mountain at Arlbert Pass, Austria, he took the ten-mile tunnel from Bludenz to Sandeck. Not understanding the German signs he was surprised at the east end by a seven dollar toll. At Salzburg, he expected the repeat of great Vienna music, and was directed to a Mass. Being very ordinary, he stayed for another Mass. Without heat for three hours, he "froze" and disgustedly hit for a Hofbrauhaus for an excellent and welcome Wienerschnitzel dinner. Several "Zimmers" at which he bunked, raised chickens. When he tried to determine production by naming five eggs daily, the German hostess brought him five eggs in a bag—her interpretation.—Co-Secretaries: **Russ Ambach**, 216 St. Paul St., Brookline, MA 02146; **Dick Shea**, 7 Barkley St., South Yarmouth, MA 02664

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The final meeting of the Alumni Council in April found **Jim Howard**, **Ed McLaughlin**, and Elinor and **Sam Spiker**, and your secretary in attendance. **Ed McLaughlin** reported that he had attended the meetings marking the 120th anniversary of the Institute's Department of Civil Engineering. . . . A note from **Arch Nickerson** in Duxbury, Mass. indicates he is enjoying life one day at a time. The present status of his eyes precludes night driving so he doesn't plan to attend the reunion. . . . **George Kohfeldt** writes from Dallas, Tex. that he and his wife enjoyed a stay at Athens and the surrounding area last August. They followed that with a cruise on *Royal Viking* to ports on the Mediterranean and Black Seas. In March they were driving to Phoenix to visit their daughter Frances Ann. They are planning to attend the reunion, stopping in Princeton, N.J. to visit another daughter, Mary Lou, whose book, *Lady Gregory, the Woman Behind the Irish Renaissance*, has recently been published.

Temple Patton has many hobbies (magic, music, and chess) and over the years has written articles and books on these subjects. He now tells us of another hobby which just recently resulted in his publishing a romantic novel, *Cosmetic Conspiracy*, a novelette, *Third Choice*, a short detective story. He sent me a copy of the book which I found provides most enjoyable reading. During his working years, Temple wrote many technical papers and textbooks. He writes that he will not make the reunion but sends best wishes to all classmates.

It is with sorrow that the passing of **Alexander C. Brown** must be reported. He died on January 13, 1985 at his home in Cincinnati. During his professional career he held positions as an engineer at the Tidewater Oil Co. and as an industrial fellow at the Mellon Institute in Pittsburgh before joining Emery Industries in 1932. He became director of chemical engineering at Emery in 1942, which position he held until his retirement in 1968.

One of the founders and chairman of the Ohio Valley Section of the American Institute of Chemical Engineers, he was a past chairman of the Technical and Scientific Societies Council of Cincinnati, Ohio, a visiting professor at University of Cincinnati and a fellow of the American Institute of Chemical Engineers. Alex was a long-time member of the First Unitarian Church of Cincinnati and the Charter Party. He supported and was active in a host of civic and cultural organizations in the city. He was also an accomplished pianist. He is survived by his wife, Rachel Gilbert Brown; two children, Theodore C. Brown of Union, Ore. and Jane Brown Macleod of Pittsburgh; five grandchildren; and two great-grandchildren.

Two other classmates have passed on. **Theodore W. Franks** died in Chicago, Ill. in June of 1984 and the Right Reverend **Charles J. Kinsolving** died on March 14, 1984 in Santa Fe, N.M.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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On Sunday of this week we attended the Spring meeting of the Cardinal & Gray Society at the M.I.T. Endicott House in Dedham. The grounds were most beautiful on a day that was cool but clear so that it was possible to walk among the blossoming trees and shrubs. Bob Dean and his charming wife Ruth were present and I discovered, belatedly, that she also had attended M.I.T., Class of '29 in architecture, where she first met Bob. She told us that Bob was continuing to work as intensively as ever on his practice of architecture as chairman of the board of Perry, Dean, Rogers of Boston. The Cunninghams were present, after just returning from the Caribbean and looking tanned and healthy—they keep moving around the world, chiefly on M.I.T. trips, but also domestically to another home address. The **Ben Margolin**s were also present and **Marvin Pickett**, but we missed Evelyn and **Bob Dawes** who had been listed as attendants.

For the first time in M.I.T.'s history we have a woman as president of the Alumni Association following some 89 male predecessors. Mary Frances Wragley gave a very interesting history of the growing influence of women in student, alumni, faculty, and public affairs, with a student body now of 28 percent.

Marvin Pickett called a few weeks ago to tell us of the death of our mutual friend and classmate **Bill Hoar** at Silver Springs, Md. In 1926 Bill, Marvin, and I had worked together at the Phoenix Bridge Co. and had then gone our separate ways. Bill had spent most of his career in railroad engineering in the U.S. and in many places abroad interrupted by a number of years with the U.S. Army in Europe. He and his wife had adopted children, most of whom became world travelers and whom he enjoyed visiting in his later years. A few years ago Bill returned to Boston from Pakistan where he had been visiting one of his adopted daughters who was married to an employee of our foreign services and then moved on to Maryland to be near others. He is survived, I believe, by five of his adopted children.

A very interesting letter from **Edwin E. Spitzer** enclosed a clipping from the *Lancaster* (Pa.) *Journal* announcing the death on April 17 of **Francis A.J. Brown**, 82, after being stricken while doing gardening near his home. He had retired in the late '60s from Armstrong World Industries after 31 years with the firm as project engineer. He was active in the Unitarian Church service committee and other community services and an avid gardener, having planted more than 50 different tree varieties on his own land. He is survived by one daughter and one son, one granddaughter, three sisters and one brother.

Ed Spitzer's letter tells of his shock at Francis' sudden passing since they were close friends and members of the same church. Francis had made several notes after his heart attack, the last of which was, "It's a lovely day!"

Edwin's letter continues: "I've been in retirement since 1970, after 43 years with RCA. My wife and I traveled extensively as long as she was living, and I have continued in this pattern. Part of this winter was spent in Cuzumel and now I am scheduled on a tour to Thailand, Burma and Sabah. My four children and nine grandchildren live not far from me so we get together often." Of his classmates he corresponds frequently with **Pete Bellaschi** not only his roomate at M.I.T. but a close friend from early childhood.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

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Letter to my IBM Personal Computer Jr. from Assistant Secretary **Bud Cole**: "Now little fellow I want you to know that Dad has done a fine job of our classmates activities long before you come along. Now if you start demanding all his time you will be due for a trip to the woodshed. You are both living in a beautiful state and are entitled to get out and smell the flowers and enjoy the scenery and natural goodies that abound."

Enough palaver Bud. What's new? "I play golf three times a week. Once at Palo Alto Municipal course and twice at a private one that ranks high in the area. I am a walking golfer and have been selling electric walking carts as a hobby. Right now I am promoting the CADD'X which is the Jaguar among the carts. It is made in France and has a transisterized speed control along with other goodies that attract a lot of attention. To date it has performed flawlessly. It will take more mileage to prove its worth.

"I don't see any M.I.T. men of our era. The few that I meet are of later classes and are connected with our Silicon Valley firms. We have a active M.I.T. Club in San Francisco which is only 30 miles away but far enough to be off beat. . . . If my wife's health permits, I will be among those present at our reunion. Here's hoping for the best."

Col. **Robert T. Connor** of Fairfield, Conn., writes: "Nothing unusual in my case. Just retirement from the U.S. Army (in 1957) and now from participation in alumni activities at Univ. of Bridgeport and retired officers activity at the U.S. Naval Submarine Base at New London. In recent years, however, illness and old age have made me 'home bound.' "

Roger M. Pierce died on January 10, 1985 in West Brookfield, Mass. He worked his entire career, starting after graduation, at American Steel & Wire Co. Electrical Cable Works Worcester for 41 years. Roger retired in 1970 as a senior research engineer. His field of testing and research was in high voltage cable insulated with laminated paper impregnated with special high quality oil. For decades such cables have been the principal means of underground high voltage power transmission and are still in service. Roger was a member of Power Engineering Society and life member of AAAS and IEEE. We extend our sympathy to his widow, Eleanor and their three sons.

Received a note written with difficulty from **Dale Stetson** in Warren, Vt., saying that he is confined to a wheelchair with inability to walk more than a few steps as a result of a stroke several months ago. Very sorry Dale. You were an active fellow running your small ski lodge.

On a personal note, my family—Ruth, Nancy and Jane gave me a good 80th birthday celebration with a house full of old friends at our 6th generation family home in Epping. Among those gathered were M.I.T. graduates Herbert Stewart, '24, James Donovan, '28, Allen Latham, Jr., '30, and also Betty Jackson, widow of **Glenn Jackson**. Your secretary, from well wishers, has joined with many of you into the elite Octogenarian Club.—**Joseph C. Burley**, Secretary, Box 416, R.F.D. #3, Epping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Branford, CT 06405; **Prentiss I. Cole**, Assistant Secretary, 2150 Webster St., Palo Alto, CA 94301

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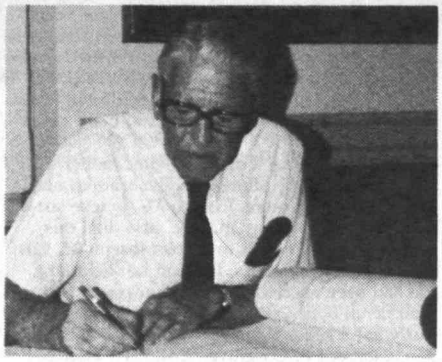
We have a very welcome letter from **Frank Taylor** enclosing a photo snapshot taken as he was signing a work of unusual interest and importance. The work, the Historic American Merchant Marine Survey, PWA Federal Project No. 6, was a Depression project in which Frank had a prominent part. In Frank's words: "The survey was designed to engage unemployed marine architects, draughtsmen, historians, and shipyard workers to record the design of wooden sailing vessels still working on our coasts and rivers. When the Smithsonian Institution agreed to sponsor the project, I added to my curatorial duties the work of associate director of the survey. The results, which are large drawings of hull lines, deck plans, construction details, and sail plans, have been in nearly constant use by mail orders and



Frank Taylor

study at the Smithsonian. The value of the work has increased to justify its publication for wider accessibility. It was privately published by the Ayer Co., Publishers, Inc., Salem, N.H. The huge seven-volume set weighs 109 pounds!"

Lazare Gelin took a trip to Boston in the month of May to visit his daughter. We were pleased that he could join with Florence and me (your secretary) for lunch at the Faculty Club. He had just returned from a three-months stay in Europe and was looking forward to a busy summer at his home in Westport, Conn. Lazare admits to being in very good health. . . . The spring meeting of the Cardinal and Gray Society was held at M.I.T. Endicott House in Dedham, Mass. on May 12. There was a good attendance that included these '28ers: Rose and **Maury Beren**, **Jim Donovan**, Dorothy and **Gus Rogowski**, Florence and **Walter Smith**. Frannie Donovan did not attend since she was busy elsewhere receiving a very special honor. The Peter Bent Brigham School of Nursing held its final graduation exercises on May 12. Frannie was awarded an honorary graduate nurse certificate in recognition of her many years of service as chairman of the school's advisory committee. This was wholly unexpected and she was deeply touched. To you, Frannie, our heartiest congratulations!

Some miscellaneous telephone calls produced the following brief notes. **Walter Anderson** has moved from his home on Cape Cod to North Reading, Mass. to be nearer the family young people. Speaking for himself, Walter says his health is good. . . . **John Hartz** spends his winter months in Florida and, when we talked with him in mid-May, he was about to leave for England. . . . **Bob Krummel** asked how the 55th reunion T&S classbook had turned out. We sent him a copy so he could judge for himself. . . . **George Bagley** says he mostly stays home now but his health is okay. . . . **George Bernat** wrote to tell us that he and Ruth would be coming to Boston in early June for her 50th class reunion at Simmons College. At the same time their son and his family would be at Harvard for his 25-year class reunion. George says that he sees **Bill Grunwell** on occasion. . . . A brief note from **Alex Tsongas** says that they are enjoying good health and traveling in the U.S. to see their four children and four grandchildren. Then they will be off to Greece to continue their genealogy research.

A note from Marjorie (Mrs. **John) Carvalho** said she would have to miss Technology Day this year. However, Helen (Mrs. **Robert) Harris**, Mary (Mrs. **Arthur) Nichols**, and Janet (Mrs. **John) Chamberlain** Sawyer all expresssed their intention to attend in part, at least.

Many of you may be unaware of the Jope Cup that is awarded annually at the Spring Championships of the Eastern Association of Rowing Colleges (EARC). The cup was given to the Association by M.I.T. in 1963 and named in honor of our deceased class president, **Ralph T. Jope**, who did much to promote the sport at M.I.T. The award is made to the winning college whose lightweight crews achieve the highest

number of points through a rather complex scoring formula. This year Princeton University won the cup at Lake Quinsigamond, Worcester, Mass., and Ralph's son, Theodore (Ted) made the presentation. For the two years prior to his death Ralph made the presentation himself.

With deep regret we must report the deaths of the following two classmates: **Harold A. Harrington** died on July 16, 1984. He was a graduate in Course IV-A, architectural engineering. During much of his active life, Harold was postmaster for the community of Graniteville, Mass. . . . **Albert H. Shedd** died earlier this year (1985), but we do not yet have the exact date. Al graduated in Course II, mechanical engineering, and was employed successively by several prominent West Coast engineering firms during his professionally active years. To the families of these classmates we extend our heartfelt sympathy.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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Arnold S. Wood of Osprey, Fla. and his wife Barbara are enjoying their retirement years in the gentle climate of the South. They have three children, ten grandchildren and five great-grandchildren. They enjoy good Florida weather and each added birthday. . . . Colonel **George D. Rogers** of Fairfax, Vir. has just celebrated his 88th birthday. His eyesight being poor, his wife Hope helps him write his letters and notes. He likes "talking books" and TV. He says, "my wife always enjoys reading the poem 'Salutation to Dawn' on the Class of 1929 birthday card. A remarkable way to look at life. Thanks for my birthday greetings and best wishes to all." . . . Mary and **Frank Mead** are about to leave their winter quarters in Northport, Fla. for their summer home in Marion, after a glorious season of golf, bridge, and other social functions. Frank is a member of M.I.T. Club of Southwest Florida where he and his wife attend most of the functions. This year, they missed the high point of the season, an annual barbecue at the estate of the late M. Hall, M.I.T. alumnus, at Casey Key, Fla. His wife has been carrying on the traditional event. Upon reaching their home in Marion, Frank has a number of chores to do, including putting ten lobster pots in the water and preparing the family flower and vegetable plot for planting. Frank also belongs to the Kittansett Country Club, where golf, bridge, and other social events await him. This year Mary will be celebrating her 60th Leslie College reunion with great distinction, having participated and served in the Alumni Association for many years. She is in charge of a matching fund raising for her class. Frank lists his hobbies as golf, fishing, oystering, gardening, clamming, and bridge.

Edwin H. Perkins of Georgetown, Mass. is still active in the U.S. Power Squadron. He is now an educational officer for District 18 (Essex County) encompassing five squadrons. He continues his duties as chaplain of his Masonic lodge (c.c. Dome), chaplain of the 10th Lodge of Instructions (Masons), and treasurer of Eastern Star (Chapter 176). He still has his 26-foot sailing sloop which he enjoys as often as can. He states that his health is good and he is trying desperately to keep it that way, so he can watch and enjoy his granddaughters growing up. . . . When I received **John McCaskey**'s death report (reported in the July issue), I sent the sad news to his very best friend, **L.R. Bill Aldrich, Jr.** of Billings, Mont. I received a reply as follows, "I had a strange feeling about John, so around the first of the year, I put a call to his home in St. Joseph. The person answering the phone informed me that he had gone to the hospital—nothing serious. . . . Yesterday, I received your note, and today I received a newspaper clipping announcing his death. Last year was a bad year for our 'gang.' A year ago, we were talking about a reunion—then everything seemed to cave in! First **Bob Gray** passed on, then **Wally Gale,** followed by **Gus Stein** and now **John McCaskey**. We all met and lived together at M.I.T. 60 years ago. We had lots of good times together. It is almost like the story of *Gone With The Wind*. I am still active and plugging along, following your good advice."—**Karnig S. Dinjian,** Secretary, P.O. Box 83, Arlington, MA 02174

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This month information forms were returned by a plurality of "W's." **Wes Wedemeyer**, an architect and real estate broker in St. Louis, reports that he is still active as president of Planning and Construction Consultants Inc., a firm that acts as a consultant and advisor to long-term real estate lenders. Wes is a member of the International Executive Service Corps and has had assignments in four foreign countries. . . . **Bert Whitten** spends April to November in Searsport, Me. and the winter months in West Roxbury, Ma. While in Maine he keeps busy doing home repairs and some gardening. He reports being hospitalized for a couple of weeks in January with a heart problem from which he is slowly recovering. . . . **Tom Wigglesworth** is one of our more active classmates. He sold his business, T.R. Wigglesworth Machinery Co., to his son and has now formed a new enterprise which operates under the name Wigglesworth Ventures, Inc. and engages in joint ventures in the machine tool and manufacturing fields. He plays tennis, paddle tennis, some golf, and rides a bicycle. His memberships include, in Cleveland, the Rotary Club, the Skating Club, and the Country Club, and in Naples, Fla., the Royal Poinsianna Country Club. He hears periodically from **Bob Nelson**.

Bill Wanamaker's wife Nancy was kind enough to return the form I sent with the sad news that Bill has lost his eyesight. However it appears that in spite of his failing eyesight he is able to work on his "computer setup." . . . **J. Palmer Boggs** writes from Fayetteville, Ariz. that after years of teaching and consulting structural engineering practice he is "mostly retired." A recent non-retirement activity is his participation in the engineering design of a museum that is to be built in Los Angeles to house the Joe Price collection of Japanese art. . . . Our "writingest" classmate is **Joe Kania**, who sometimes reports in more than once a year. As described in the October '81 notes, Joe designed and supervised the construction of an "off-beat" isosceles triangular house in Vancouver, where he now lives. He recently sent me a newsclip from the *Vancouver Sun* of a feature article about his house. Joe says dozens of people come to the door and ask to see the house or tell him to let them know if he ever decides to sell it. Joe did a great deal of traveling at one time but now, because of his wife's health, sticks close to home.

We have notices of the deaths of two more classmates: **Wally McDowell** on March 2, 1985 and **Myron Smith** on February 18, 1985. My records on Wally (which could be out-of-date) indicate that he was a long-term employee of IBM in Binghamton and a dedicated fund-raiser for M.I.T. in the Binghamton area. At the time of his retirement in the early seventies he was research and engineering vice-president of IBM. Thereafter, he and his wife Louise, who predeceased him, moved to Naples, Fla. where he was living at the time of his death. He is survived by three sons: William, executive vice-president of Phillip Morris U.S. in New York City; Alan, owner of a small food chain in Minnesota; and John, an account executive with a Minneapolis advertising firm, as well as eight grandchildren. . . . **Myron Smith** worked for General Radio (later GenRad, Inc.) in Concord, Mass. for 37 years. He was vice-president for sales at the time of his retirement in 1968. Thereafter he spent winters at Siesta Key, Fla. and summers at his home on Sebago Lake, Casco, Me. Like Wally, Myron was a widower at the time of his death. He is survived by two daughters, Laura Lynch of West Barnstable, Mass. and A. Bonney Stearns of Portsmouth, N.H. and seven grandchildren.—**Gordon K. Lister**, Secretary, 249-B Heritage Village, Southbury, CT 06488

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Five classmates and their wives turned out for the Cardinal and Gray Society meeting at M.I.T. Endicott House in Dedham, Mass. on Sunday May 12, for a fine lunch . . . and an interesting presentation by Mary Frances Wagley, president of the Alumni Association, on the place of women at the Institute, historically and at present. Among 80 attending were classmates Charlotte and **Ed Hubbard**, Mary and **Gene Branca**, Mildred and **Charles Seaver**, Katherine and **George Manter**, and Louise and **John Swanton**. It was a most interesting session and a good chance for fellowship.

A note from **Ed Worden** says he's coming along fine and should be through with his round-the-clock penicillin every six hours by May 15. Hope and **Randy Binner** called on him a few weeks ago and took him and Helen out to lunch—first time out since his illness—and it was a delight. It was an exceedingly great delight to get out of the hospital.

John Hollywood is now living in Red Bank, N.J. with his brother and sister. His amateur radio is again in action, WISK. . . . and Hester and **Ted Morrill** have been living in Amherst now for some years, where they are active in senior affairs. Ted is now serving as chairman of the Council on Aging, Town of Amherst. . . . We have the sad news to report that **Paul Davis** of Vero Beach, Fla. died December 1, 1983. For some reason this word was delayed in reaching us.—**John R. Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158; **Edwin S. Wordon**, Secretary, Box 1241, Mt. Dora, FL 32757; **Ben W. Steverman**, Assistant Secretary, 2 Pawtucket Rd., Plymouth, MA 02360

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Robert Strong responded to the class Christmas greeting with a very welcome long letter. He regrets not being able to attend the mini-reunion as he was committed to attending his granddaughter's affair at Rollins College. His activities—golf, swimming, and billiards—were interrupted in 1984 for a few months because of a severe slipped disc problem. With the aid of intricate medical help, a steel brace was inserted—and so far it has worked and he has no more pain. His wife Louise has recovered from a bad motor accident in 1983. They now have eight grandchildren as well as their own three children. Keeping up with them keeps the Strongs busy. Bob does consulting work from time to time which takes him out of this country, but at present he is content to stay in good old U.S.A.

Maxine and **Wendell Bearce** keep very active. In 1984 they spent two weeks in Greece and then took an 8,400-mile auto trip to Vancouver, San Diego, Jacksonville, Myrtle Beach, and then back to Ohio. In winter 1985 they go to Bradenton, and in May they head for a long trip to Israel. Wendell says he usually sees **Jim Demas** every year. Jim's wife is scheduled for a serious operation in Pittsburgh.

Jane and **Harold Anderson** sent us their annual Christmas circular that they send to their friends and relatives. They enjoy very much working for and with the Galilean Baptist Mission. Religion does much to give meaning to their lives. Their children and grandchildren are all busily engaged in worthwhile activities. Harold is still adjusting to hearing aids. . . . When the civil engineering colloquium was recently held for the 120th anniversary of civil engineers, our class was represented by Mr. and Mrs. **Albert O'Neil** and Mr. and Mrs. **Albert Dietz**. . . . Another one of our classmates celebrated his 50th wedding anniver-

sary. Betty and **Kenneth Smith** were entertained by their children and grandchildren in Kansas City. They say, "It was worth waiting for." I would like to publish picture's in this column of all classmates celebrating their 50th anniversary. Don't be bashful—send them in. . . . Colonel **Arthur La Capria** still enjoys riding horseback three times a week. He is getting ready for a month's photo trip to northwest Wyoming.

John Crowther died in October 1984 at his home in Old Lyme, Conn. He was a chemical engineer with several companies and was a chemical warfare officer during the war. He was also an avid sailor, a ham operator, and gave courses on historical subjects. He is survived by his wife, two daughters, a son, and two grandchildren. . . . I must also report that Mrs. **Amy Higgins** died in 1982 and that **Sterling Slockbower**'s death was recorded by the Alumni Association in 1985. . . . **Francis Bertil** died on June 11, 1984. I will forward obituary information when I receive it. . . . **Edwin Beck** died on May 31, 1984. He is survived by his wife, son, daughter, and five grandsons. He worked for Sealed Power Corp. in various technical capacities and responsibilities. He had many hobbies especially car restoration and stained glass.—**Melvin Castleman,** Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Summer has about gone. Pretty soon we should be getting letters and cards of activities for Class of 1933 during the vacation period. Do your part and drop your secretary a memo and mention some of the people you remember from Cambridge so long ago.

Ellery Clark hoped to get to the Mexican Fiesta last march, but we have no report from him. Does anyone know?

Dayton Clewell did go to Mainland China with a group of engineers who talked with educators about how engineers are trained and used in the States. He stopped by to see the Whittons on his way home from Florida in the late spring. We had a delightful two days. When we were in Cambridge there were only three students from N.C. With so few, alumni in N.C. are scarce today. We welcome visitors. Come see us.

Tuition for 1985-86 has gone to $11,000 with board and room up to $4030, according to *The Tech*.

Remember that steel window. . . . no sooner was *The Review* delivered than there was a letter from **Bob Forbes**, who lives in Knoxville, saying that he was the lucky man at Norwich Inn in 1938. Bob was able to sell it for five or ten dollars to a friend who was building a cabin. Bob sang in the M.I.T. Glee Club and still sports a Baton Key. He is an officer in the local S.P.E.B. S.Q.S.A. and will have a part in the international contest in Minneapolis this summer. Some of you singers drop me a note of your recollections of Baton.

Warren Henderson writes that their marriage continues happily, getting smoother every day. . . . **Bill Pleasants** sends a clipping of a one-house sewer system he designed for use at beaches.

There is news from **Frances Varney Marshall (Polly)** one of our lady architects. She and **Edward Walker Marshall** were married before leaving Tech. They lived in Washington during World War II, where she worked for the Federal Power Commission. Now she lives in Weston, Mass. and has served on the school committee, the historical commission and now records oral history from the "old folks." She does watercolors, skates and skis.

I wonder if we have more co-eds than the names I picked up a few months ago. Let's hear.

Stan Walters writes that he attended all our reunions except the 10th. . . . who else has any such attendance record? His office is in the basement of his barn with a piano-playing apartment dweller overhead.

The Alumni office sends word of the death of **Henry E. Kiley** who was living in Chatham, N.J.

Walter Skees who lives in Barcelona says, "Come see me." The exchange rate is all in our favor. He recalls that he worked on *The Tech* with **Dayton Clewell** during their sophomore year and says Dayt was one of his best friends.

Rene J. Marcou says that someone else must have reported on him earlier. Here is the straight dope: He completely retired in 1970 and has traveled extensively including visits to France, Philippines, Alaska, England and Scotland, and has the Rhine in his plans for 1985. . . . sounds like our friend **Al Mayer** doesn't he?

I like picture postcards especially if you fill up the back with news.—**Beaumert Whitton**, Secretary, Cottage 112, Sharon Towers, 5150 Sharon Rd., Charlotte, NC 28210

34

It is a relief to be faced with news of only one loss this month; that of **David L. Foulkes** of Oakland, Calif. According to information from the M.I.T. Club of Northern California he died January 23, 1985. I have no other information except that he is survived by his wife, Mary, to whom I would offer our condolences.

I hope there are more members contributing to the Alumni Fund than I'm getting Fund notes from. There are two this month. **Warren Kunz** says: "We're enjoying our new location right on the water, one-quarter mile to Chesapeake Bay up the Piankatonk River. Old friends are always welcome—lots of room." For anyone who might want to drop by and see Warren, his new location is Box 636, Rt. 1101, Deltaville, Va. 23043.

Larry Stein seems to be the latest to succumb to the lure of higher education. He writes, "It is interesting to be back in college after 50 years. I am enrolled in a computer course at Univ. of Massachusetts (Boston) and enjoying it, but it is hard work."

I'm "visiting" Brewster for 11 days between the "Belgium and Holland in Bloom" trip I mentioned last issue and my departure for a month in Eastern Europe. The trip just past was the one that **Paul Wing** and Clare were also part of the group. The weather was on the dull side but we did see some beautiful horticultural exhibits: the Royal greenhouses in Brussels, the bulb display at Keukenhof near Amsterdam (it was very fine—there had been a warm enough spring and we had good sun for pictures), the gardens at Monet's house in Giverney (about 30 miles from Paris), and the general prettyness of the countryside in spring. The most unusual visit, and a new one to me, was the flower auction at Aalsmeer, not far from Amsterdam. It is an incredibly organized and mechanized affair; the building must cover nearly ten acres and they daily handle thousands of flowers, mostly cut, in six auction rooms. At ten a.m. we watched flowers being sold, many of which would be bound all over the world by air freight by 2:00 p.m. If you're ever visiting Amsterdam, by all means try to see it. Beyond these places there was the general pleasure of sightseeing—some to new sights and some pleasant revisits, like Paris itself.

I'll be back from Jugoslavia, Romania, etc. just in time for the next batch of notes. After that I'm staying home to let me and my bank account recuperate. So it will be up to you to send me material for later columns.—**Robert M. Franklin**, Secretary, P.O. Box 1147, 620 Satucket Rd., Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20815

35

Here is a letter from **Bill Parker** of Bella Vista, Ark.: "Marjorie called **Otto Zwanzig** Saturday. They are not planning to attend the reunion. Friends of theirs in Spain have offered them the use of their villa for parts of May and June. The Zwanzigs leave shortly for a drive across the country visiting children and other relatives after which they leave for Spain and return on June 20. We hope to see them at our cottage on the Cape when they get back. They also report that the **John Moorings** have decided against coming and are presently touring in the Caribbean. We are hustling around here to get things in order as we have to be in New Hampshire by May 17 for Marjorie's 50th and there are oodles of things to get organized here for a seven-week absence. See you in Cambridge." I shall be at the front door!

Here is a letter from **Larry Hall**, Amherst, N.H.: "In reading the latest class notes I reminded myself, once again, that in all these years I had never written a note to the '35ers. So once in 50 years here goes. After my small part in the war effort, mostly in the Canadian Arctic, Betty and I settled down in Manchester, N.H., where I went to work for the New Hampshire Insurance Co. from which I retired after 35 years, the last 15 of which as its president. We have two sons, both engineers. Dave now 40 was Yale, '65, and M.I.T. Sloan '67. Larry, Jr. was Course I M.I.T. Class of '67 and S.M. '69. Betty and I have spent our summers at our farm in Wilton, N.H. a rifle shot away from the farm of the late Ernie Van Ham. We've had a lot of fun both working and retired so I don't mind too much the constraints put on me by surgery on my skull last December to slow down a malignancy. I'd be remiss if I didn't say thanks to you and your predecessor secretaries for keeping some of the old strings tied through the years. Hope the Class of '35 has a good reunion." It was a nice surprise to hear from you, Larry, your name has come up many times at past meetings at M.I.T. We all wish you the best and are sorry not to be seeing you.

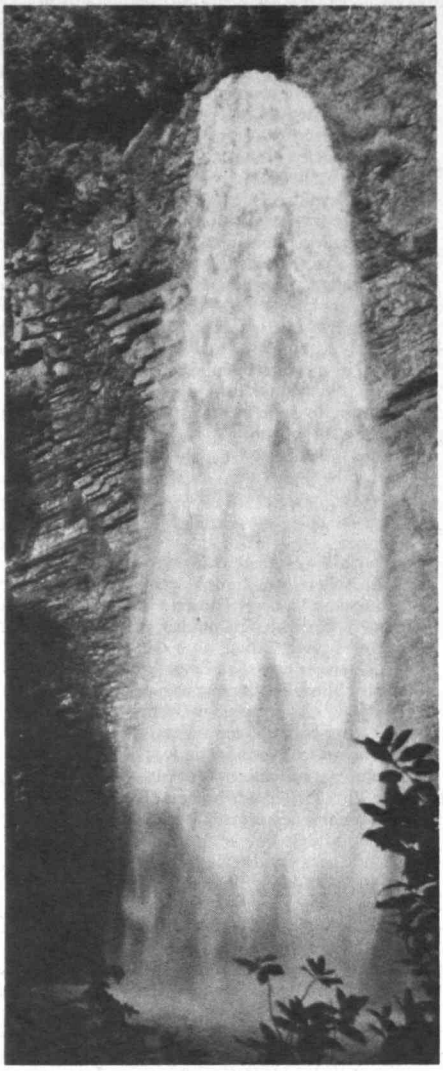
In the next issue of the *Review* I shall try to give you highlights from our 50th. We have a record number coming and a hard working committee has been hard at work putting it all together.

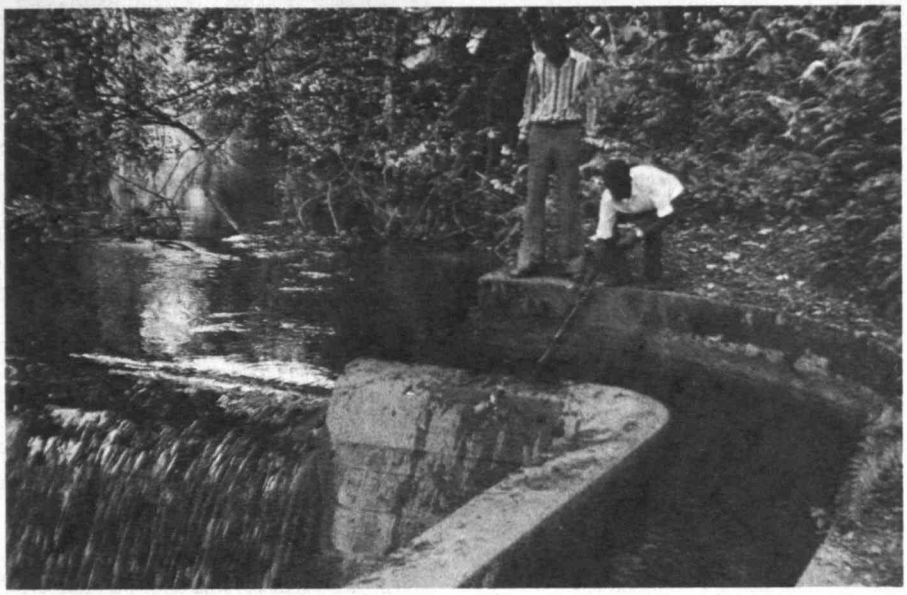
I am sorry to report the death of **Luis A. Dastas** in Miami in January, 1985. Luis was with our Freshman year.—**Allan Q. Mowatt**, Secretary, P.O. Box 524, Waltham, MA 02254, (617) 899-0358

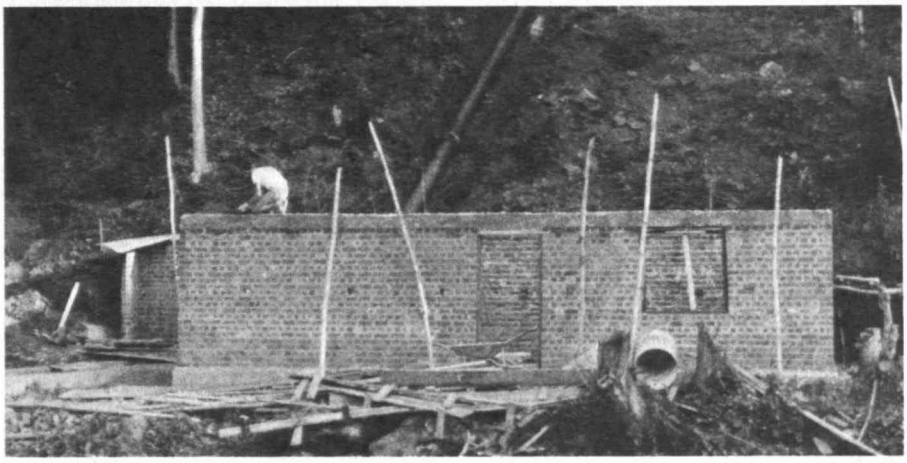
36

Just as these notes were due I received a sad telephone call informing of the death on May 15 of **Dana Devereux** who had suffered a heart attack while playing tennis a few days before. It comes as a shock—Dana attended our last reunion planning meeting. He was retired from Emerson Consultants, Inc. in New York but continued to do a bit of consulting after ceasing active participation as president of the firm. His widow, Harriet, lives at 26 Weeburn Dr., New Canaan, Conn. 06840. I have written to her to convey officially the sympathy of the class. . . . Belatedly, from the Alumni Office I have learned of the death in June, 1984 of **George B. Payne** who was retired as maintenance supervisor with the DuPont Co. in La Porte, Tex. He is survived by his wife, Miriam (P.O. Box 482, Bacliff, Tex. 77518). . . . **Carlyle W. Jacob** died February 18 in Quincy, Mass. Although the obituary notice called him a self-employed physicist, he had at various times been associated with Itek Corp. After graduation he stayed on to earn an Sc.D. in physics. He is survived by his wife, Marcia (118 Presidents Lane, Quincy, Mass. 02169) and three daughters.

Once again some of the class will gather at my home in West Hartland on the last Saturday in October, the 26th. This may be your only chance because if all goes as planned I will take an extended trip west in the fall of 1986! (My new Plymouth Voyager is a very satisfactory camping vehicle.) If you even hope to join us let me know early enough so that I can send you a map. This is a cooperative affair and the coordinator is Mary Assmann, 17 East Curlis Ave., Pennington, N.J. 08534. There will be no written notice of the "mini." You will have to take the initiative and get in touch with Mary and Fred. I'll hope to see







The above rural electrification, for Kisiizi Hospital in southwest Uganda, was planned by Enar Eskilsson, '34. The free fall (left) is about 30 meters high, and the concrete dam across the river (top right) and concrete channel at the side lead the water to the power station below. A pipe line from the channel runs to a turbine in the station. Financing for this third world project was arranged through the Swedish International Development Authority and an organization in England and one in Germany.

Rural Electrification for the Third World

"We live in a world where two-thirds of the people and seven-eighths of the countries are unable to meet the people's basic needs or develop their national resources," says Enar Eskilsson, '34. To meet this challenge, he reports that around 160 nations have joined together to improve the conditions of human life, particularly in the developing countries.

The world's largest agency for channeling technical cooperation, he says, is the United Nations Development Program. This agency works with over 150 governments and 35 international agencies and has at its disposal around 10,000 field experts and an annual operating budget of about $800 million. The biggest sums are given for agriculture and then the development of natural, industrial, and human resources.

In addition to government organizations, Eskilsson points to the many volunteer and non-government groups, such as the churches, who offer aid to the less privileged. A former private consulting engineer and United Nations expert, he has more recently been involved with electrification projects in developing countries supported by the Swedish International Development Authority and the Swedish Missionary Council Office for International Development Cooperation.

Eskilsson expresses hope: "The wealth of the earth's resources, the ingenuity of its people, and the power of today's technology offer promise of liberation."—*Sandra Knight* □

some new faces along with the many regular ones.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

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Elizabeth and **John Jacobs**, 2555 Leavenworth St., San Francisco, Calif. 94133 write, "This has been a good year for us all, Karen and Jeep are even more wonderful and lovable than ever and seem to be leading happy and fulfilling lives." John's wife, Elizabeth has been concentrating on her sculpture and is producing beautiful things. John's activities include 100 days skiing, 100 squash games, lots of windsurfing, rowing on the bay and plenty of bicycling. He has been writing Computer Aided Design (CAD) software and is now vice-president of MOMS Computing, Inc., working mainly at home and at Tahoe. He has given up his other consulting work. John writes, "I am now a serious rower (160 miles in September and October). Usual route is around Alcatraz. It's a mystical experience—like a runner's high—building up as I listen to Bach or Mozart, enchanted by the rhythms—oars, waves, diving pelicans and cormorants and all those boats. A sauna tops off the experience. Music adds another dimension of feeling good, which is what it is all about for skiing, rowing and biking."

Henry J. Rugo, Conant Rd., Box 271, Lincoln, Mass. 01773 is retired from Mitre Corp. as research project manager. Now he is Lincoln, Mass. representative, treasurer of advisory board and member of executive committee, North Solid Waste Committee (first revenue-sharing, regional resource recovery project to dispose of municipal solid waste with energy recovery through electric generation). Volunteer work: member of board, Lincoln Historical Society and Community Publications Committee; board member, Boston Associates American Scandinavian Foundation; officer, Lincoln Minute Men; various environment-related activities, including Sierra Club member and activist; active in support of town library. Travels have included Iceland, Portugal and Mexico. Wife Faith is a language teacher and Dean, Middle Division, Carroll School. Children: Jason M. is married to Carol Cripps and is practicing law in St. Louis, Mo. Hope S. is just finishing her first year of residency in internal medicine in San Francisco. Adam M. is a third year student at Washington University, St. Louis, Mo. and spent his spring '85 term at the University of Strasbourg in France. Henry writes, "Looking forward to meeting classmates and friends at 50th—hope many will be there! Have talked recently with **Lester Klashman**, **Bert Bennison** and **Dick Henderson**. Attempts to reach or get definite word of **Jim Abdou** unsuccessful—would welcome any news." Col. **Joseph A. Smedile** (3579 Admirals Way, Delray Beach, Florida 33444) writes in his Christmas letter: "As far as our health we have much for which to be thankful. During the past year we have had some 'pluses' and some 'minuses'. Nothing serious though. We subscribe to the old Army Air Corps saying: 'Any landing you can walk away from is a good landing.' Nuff said! In late January of this year we took a cruise through the south China and Java Seas. The 17-day trip took us by air from Miami to Hong Kong where we boarded the Royal Cruise Line ship *Royal Odyssey*. From there we sailed to Manila and Zamboanga (both in the Philippines), then on the Bali, Surabaya and Jakarta, all in Indonesia. Our last stop was Singapore. After a two-day stay ashore we returned by air to Miami. Shipboard life was outstanding. For Martha, in her wheelchair, it sometimes was exciting, particularly when transferring her from or to a motor launch that was bouncing around. Our son, Gary, bid for a TWA job opening at the Kansas City airport and was selected. (He is now passenger services manager.)" For Joe, the biggest thrill was to go back to Zamboanga where his battalion had made a D-Day landing during World War II. His unit had constructed a dirt field by D+5 and an asphalt runway by D+30. They visited the airfield but found that many changes had been made during the past 40 years. "It is no longer our airfield," Joe said. "It is theirs." Martha continues with problems with their new house. "We started the New Year with a clogged kitchen sink which thus could not be used. Roto Rooter people broke two bits trying to clear the line, but couldn't. Another plumber was called. He opened up the wall of our house from the outside and was able to clear the sewer line from there. He found that the pipe had settled and bowed as the underlying soil had settled. (The pipes had not been suspended from the concrete floor as they should have been!) In May of this year we found the overhang over our front door had pulled away from the house. Since it weighed about two tons, we hired a local contractor to shore it up temporarily. After much correspondence and many negotiations, the carrier agreed to rebuild it. This they did during October and November. We won't tell you what the workmen did to our adjacent landscaping. During the past year we have been favored by visits of Gary and his family. Other guests included a number of people from Joe's old home town in Massachusetts or from M.I.T. We have had several visitors from Wilmette, Ill., and others from Bolivia. It was great to see them all. Of course our greatest joy was in seeing Tommy (aged four) and his brother Jack (aged one) who came with their parents, Gary and Pam. Tommy even stayed solo with us for about a week. You should have seen the fish he helped land! He will remember that for a long time. We are sure he will also remember the ant hill on which he sat just before the fish was hooked. Poor little boy!

I regret to report the passing of **Melville E. Hitchcock** on March 9, 1984. His last address was 22 Riversedge, Ivoryton, Conn. 06442. Besides his wife Dorothy Penny Hitchcock, he leaves three daughters, Margaret H. Thiel of Minneapolis, Lisa Blodgett of Erin, Ontario, and Carolyn Hitchcock of St. Thomas, Virgin Islands, and three grandsons.—**Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155; **Lester M. Klashman**, Assistant Secretary, 289 Elm St., Apt. 71, Medford, MA 02155

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Ed Hadley's report in the July notes that **Don Severance** was retiring in June was slightly premature. The Institute has decided that it can't get along without him, so he'll be on a two-day-a-week basis for another year. Don, our traveling class president, had lunch with **Fred Reuter** in Cleveland. Fred continues as a consultant with Norm Klivens, '40, at Western Reserve Associates. Don also met with Louise and **Dick Muther** to discuss our forthcoming 50th reunion (remember 1938 in 1988!). Dick is getting out of the consulting firm he started many years ago, and is doing a little consulting on his own. . . . Don went on to Washington to see **Corny Roosevelt**, who continues to maintain government contacts and serves on the board of Aerospace Corp. Corny continues as the class's most avid and experienced scuba diver, while he still finds time for hot air ballooning here and abroad. . . . While in San Francisco, Don visited **Pete De Florez**, who has endured a seriouus back problem for many years, and was recuperating from his most recent operation. . . . Then, on to Palo Alto for lunch with **Ira Lohman**, retired from IBM and living in Saratoga, Calif. Ira and Louise are now professional photographers doing all their own laboratory and darkroom work. . . . In Los Angeles Don had lunch with **Ben Thompson**. Ben got his master's in 1938, and is still working for Aerospace Corp. His hobby is a big theatre pipe organ, which he is restoring. He bought a "retirement" home in Ojai, because it was big enough to accomodate the organ.

The April meeting of the M.I.T. Club of Los Angeles had as its speaker **Ascher Shapiro**, and as guests, **Harold Strauss**, **Welcome Bender**, **C.C. Wong**, **Doc Wochas**, and, or course, Don. Another 1938 mini-reunion! . . . **Walter Johnson** writes that he is still enjoying retirement at Ft. Myers Beach, where he keeps busy doing volunteer work at Memorial Hospital, and keeping peace in his neighborhood as president of the local property owners association. . . . Another retiree, **Norman Stewart**, keeps busy as finance officer of the Worcester County Council of the American Legion, as well as finance officer of the State organization of the 40/8.

Joseph Bryan received a special achievement award from the American Meteorological Society for outstanding foresight and achievements in statistical weather forecasting. . . . A note from **Fred Kolb** included a clipping on **Vernon Lippitt**, who passed away after a five-month bout with leukemia. Vern had made a career of teaching and writing on economics. On a brighter note, Fred says that as a senior member of Kodak Research Labs, he is very busy tutoring the youngsters, and helping them to appreciate what ancient mistakes they are repeating.—**A.L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Jean and **Mike Herasimchuk** wrote from Irvington, Va., where they have a second home near a golf course and a lake. The area attracts golfers, fishermen, birdwatchers, and beavers. For these many years (before the move), Mike believed M.I.T.'s mascot was the beaver because it enjoyed contesting the frigid regime around the Charles River Basin. As I remember Lobby's and Tubby Rogers' after-banquet comments, the beaver was chosen as mascot because he was king of engineers among animals and did his best work at night. Other classmates having different recollections (printable, of course) are invited to send them along. Mike cherishes fine memories of M.I.T. and was good enough to reminisce about some. In 1965 Mike golfed with **Hal Muckley** at a Houston convention, but they did not talk golf. Instead, they recalled undergraduate basketball at M.I.T. and the time Hal assembled a pickup team of five players from the dorms, who went to the gym and beat the varsity on which Mike was playing with Ollie Kangas, **Paul Schneider**, Verne Lippitt, Hy Katz, Tom Creamer, and Dick Wilson. Mike's golf scores over 20 years earned some tournament championships. Last year he won one of three spots allocated to the Philadelphia District, and he played in the USGA Senior Amateur Tournament in Birmingham, Mich.

Anne and **Fred Schaller** continue their many civic works from their homestead on Schaller St. in Wellesley. Their latest project is securing financing to restore their church. The Schallers' charities also recognize the animal kingdom, of which five possum members appear every afternoon at 5:00 at the back doorstep to panhandle edibles. . . . **Leonard Jaffe** is systems engineer for the Space Nuclear Power Project at Jet Propulsion Laboratory, California Institute of Technology, Pasadena. (Leonard, there are some classmates, including your secretary, who need good advice about programming their home computers in BASIC. Please send the good word to address below.) . . . We were saddened by news of the death of **Toolin R. Parks**, in Pittsburgh. There were no details.—**Hal Seykota**, Secretary, 1415 Seacliff Dr., N.W., Gig Harbor, WA, 98335.

40

These notes are being prepared before our 45th reunion, so I can't provide any information on it. Next issue will have it all! . . . **Marshall McCuen** writes that he has been retired for eight years. Time has been filled with volunteer work and travel, including Europe, Africa, and the Orient. Due to a double hip joint replacement in July 19, 1984, he has had to give up active sports. He plans to stay in his new condo in Indianapolis.

. . . Sad news to report on the death of **Louis Strymish** at his home in Newton Center, Mass. No other details available.

A news clipping reports the death of **Richmond Wilson** on February 6 at his home in Corning, N.Y. Richmond joined Corning Glass Works in 1940 and held a number of engineering positions in melting and glass technology. He had ten U.S. patents and wrote the section on tubing and cane drawing processes in *Glass: Science and Technology* recently published by the Academic Press. He retired in April 1984 and then served as part-time consultant with Corning. He was a board member and former president of the Corning Philharmonic Society and loved Beethoven. Beside his wife, Johnette, and two daughters, he is survived by three sons. . . . That's all for now.—**Donald R. Erb**, Secretary, 10 Sherbrooke Dr., Dover, MA 02030, (617) 785-0540

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William M. Bowes retired from TRW. He worked at the Capistrano test site. He plans to pursue some work in real estate at Casablanca and in San Juan Capistrano, Calif. He is planning a trip around the United States with his wife Lucienne and has promised to take your secretary to lunch when he gets to Cape Cod. . . . We have just been informed by Yasuko Solar that **Samuel L. Solar** died in June 1984. He lived in San Jose, Calif. . . . In March several of your classmates attended the opening of the new Albert and Vera List Visual Art center. Present for the gala occasion was **Frank S. Wyle** and **Carl M. Mueller**. The center, designed by I.M. Pei, '40, is a pleasant place to visit and an additional reason to come to your 45th reunion next year. you will find paintings and sculpture by Arp, Giaccometti, Dubuffet, and Max Ernst, and a whole studio of Lichitz drawings and sculptures.—**Joseph E. Dietzgen**, Secretary, Box 790, Cotuit, MA 02635

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Two news items were received for this month's notes: not much, but better than nothing. Happily, there were no obituaries.

Art Vershbow, a former member of the M.I.T. Libraries Visiting Committee, recently donated to the libraries' rare book collection a work on astronomy published in London in 1750. This book is an important link in the history of astronomy. It influenced the thinking of both philosopher Immanuel Kant and astronomer Sir william Herschel.

A note from **Hans Haac** reports that since his retirement from DuPont he has been teaching at Delaware Technical and Community College and serving as chairman of the data processing department. He remains active in the Wilmington Power Squadron (boats, that is), having charge of an educational program. All of the Haac young have left the nest, so Hans invites visits from classmates. Proving his sincerity, he obligingly sent his address and telephone number. . . . You know my address, so send news.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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It is hoped that by now the brochures from the Cascade Hotel in Williamsburg have reached everyone who is interested in the November reunion there, and that classmates planning to attend have made their reservations. Weather should be perfect—no crowds—and good companions, plus penty of action, should qualify for a happy "Mini." As of this writing, 104 (plus spouses) were considering the trip and the committee has high hopes of seeing every one of them there, so see you in November! At that time, we should be able to gather more news reports.

New retirees seem to appearing every month. **Randall Pratt** sends word that he retired from DuPont in 1974 after 26 years, and will be retiring June 20, from his University of Delaware job as a computer specialist. He claims, "I'm a retiring sort of person!" He has one grandchild and one on the way. "Will indulge in genealogy and railroads."

If you have not received any information regarding the Williamsburg Mini-Reunion (November 1—4) or have any questions, call Bud West, (804) 642-9495; or Norm Sebell, (617) 238-6672.—Co-Secretaries: **Andy Corry**, Box 310, West Hyannisport, MA 02672; **Lou Demarkles**, 53 Maugus Hill Rd., Wellesley, MA 02181

45

More deaths to report—it seems that each issue of late has had its share of sadness. **David A. Trageser** of Wayland, Mass., on Friday, April 26 at Brigham and Womens Hospital in Boston after a brief illness. Yes, it was the old ticker.

David, a Bethlehem, Pa. boy, was class marshall at our graduation and served two terms as class president in the fifties to sixties era. Dave of Phi Gamma Delta fame roomed across the hall from me during our V-12 days and I remember his vigor and enthusiasm all too well. Why David never slept in a single morning during those six semesters!

After the Institute and active U.S. Navy Reserve duty, Dave joined Dewey and Almy (now W.R. Grace) in Cambridge, followed by a stint with High Voltage Engineering before starting Volteck as a High Voltage spin off in 1969. For the past 16 years, all of Dave's energy has been directed to Volteck as its first and only president/general manager. Today Volteck Division of Sekisui American Corp. is a growth company and a big factor in the Lawrence, Mass., industrial base.

The class of 1945 was well represented by the **Tom McNamaras**, **Charlie Harts**, **Gerry Quinnans**, **Clint Springers**, plus **Dave Flood** and **Frank Gallagher** at the Memorial Service in the First Parish Unitarian Church in Wayland on May 4. Dave had served his church well—and it is not often one sees a full congregation this day and age. Our deepest sympathy goes to Mary, son Charles and daughters Alice, Molly and Katherine.

No details on the passing of **Edward V. Oxenford** in Buenos Aires, Argentina, on February 4, 1985.

My records indicate that we have lost, since about 1950, only 36 classmates or about 8 percent of that group declared "active" back in 1952; 21 of these have departed since our 35th Reunion in 1980. On balance, we are a healthy lot!

Yes, those of you that did not attend our 40th Reunion—and there were far too many of you—must await the October *Review* as these particular notes are being written in mid-May. We trust you are having a good summer.—**C.H. Springer**, Secretary, P.O. Box 288, New Castle, NH 03854

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Back in early May I had a very pleasant surprise at work when a call came from **Glen Dorflinger** in Houston. Glen's doing the Southwest Region solicitation for our 40th reunion gift. Glad Glen's doing it instead of me. I think he said we're looking at a 1.4 megabuck gift—a big target. We can do it with pledges from each of us, with up to six years to pay. If we all do a little financial planning, cash in an IRA or whatever, we should be able to make the nut. Give it the old college try!!

The other good news comes from the reunion committee—**John Gunnarson** and **Jim Craig** in particular—who have found that only the Stratton Mountain Inn (near Manchester, Vt.) would meet our criteria of date and size for the number expected at the reunion. Sounds just peachy grand

Kudos for McKusick as Chief Justice

Widespread accolades to Chief Justice **Vincent McKusick,** '47, of Maine as he began his second seven-year term as leader of that state's judicial system: ". . . a man of intellect, integrity, and uncommon courtesy," wrote Donna Halvorsen of the *Maine Sunday Telegram* early this year.

As chief justice, McKusick actually has two jobs: he presides over the Maine Supreme Court and he administers the entire state court system—47 judges, 51 court locations, and 278 employees. In his first term in this dual role, McKusick is credited with giving the courts both greater visibility and more effectiveness—rules streamlined, disciplinary systems installed, codes modernized, salaries improved.

McKusick himself takes little credit. "I think we were very fortunate in what we had to build upon," he told Havorsen. But a long-time friend, Professor Albert M. Sacks of Harvard Law School, where McKusick went after finishing two electrical engineering degrees at M.I.T., takes a different view. "He is an exceedingly modest, self-effacing person. If you were to rely on him for an appraisal, you wouldn't get much information about his remarkable qualities," he told Halvorsen.

Another tribute comes from Herbert Wechsler, retired executive director of the American Law Institute, on whose council McKusick serves. No one in that group is "more persuasive and respected" than McKusick, Wechsler says. □

to me. The weekend bash starts Friday, September 26 (1986, of course), and runs through brunch on Sunday. The Stratton is on the map as a ski resort but includes squash and tennis courts, a pool, and a full-sized golf course. Might even find another Mt. Tom to climb, as we did in Woodstock in 1981. Again a little financial planning is advised. Like cashing in all those Series E Bonds or some other suitable cookie jar. . . . Hang in there!!—**Jim Ray,** 2520 S. Invanhoe Pl., Denver, Co 80222

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Dick Baker operates his men's clothing business in the Manhattan garment district and dreams of running a lathe in the barn at his "farm" in Mamaroneck, N.Y. After many years in the garment district, Dick still wonders how a mechanical engineer became a society tailor who gives up his virtue every day that he goes to work in the jungle of the apparel manufacturing business. Dick's wife Joan helps out by managing the cash flow of the business. Dick manufactures suits for designers, fashion shows, hotels, and many individuals, particularly men who work in the garment district. Some of the big names include, Audrey, Estavez and Arami fashion shows, Palm Beach Polo Club, and Helmsley House. This contrasts from our lives in the dorms where Dick delivered the *N.Y. Times* and sold flowers for proms while I sold personalized stationery.

Weekends Dick has time for tomato plants and gardening. His children are 10, 14, 15, 20, and 21 years of age. Rich is a senior at Boston College playing varsity lacrosse. From his earnings as caddymaster in the summers Rich follows the family tradition of "pay as you go." Sally, a sophomore at the University of Vermont will study finance and banking next year in Tokyo and Switzerland where she will be on exchange study program. Sally works for the budget bureau at college and was given extensive computer training in her job.

As students, Dick and I shared many experiences in "pay as you go" while we worked for as little as $0.35 per hour.

Tom Cahill, Carl Accardo, John Dulchinos, John Hampshire and I had adjacent dormitory rooms on the fifth floor of Goodale in 1945. Tom remembers escapades on the ledge outside the windows of our dorm rooms. Now he couldn't fit on the ledge.

Tom is a staff doctor in gastroenterology at Geisinger Medical Center in Danvillle, Pa. Geisinger is a tertiary care center with 566 beds and 5,000 employees. Tom mentions the benefits of being in a large organization with 200 physicians, and 196 residents providing strong leadership and comprehensive medical treatment to a diversified population. They recently dedicated a magnetic resonance imager which is the third in Pennsylvania. They operate a helicopter and a hyperbaric oxygen chamber. Surgery includes heart surgery and kidney transplants.

Tom's wife Peg died in 1976 after they had been married for 24 years. He said it took him two years to overcome the depression that resulted from his loss of Peg. Tom's daughter, and his two-year old granddaughter, Meagan, live close by and Tom enjoys their visits. His son is at State College (Pa.). Tom went on an alumni-arranged 18-day trip to New Zealand/Australia. He would like to sail in the Mediterranean.

Harry Meyer wrote that in February he moved from the corporate staff at Stanadyne, Inc. to become vice president and general manager of the Chicago division of Stanadyne. It includes a plant in Tallahassee, Fla. They make automotive engine components, primarily hydraulic tappets and PCV valves. they are the leading supplier of same.

Denny McNear, chairman of our class's 40th reunion Gift Campaign, wrote to our class in April to solicit ideas and ask help. He asked for each classmate's choice for a project from among M.I.T.'s core needs or an alternative. Also, he asked for volunteers to serve on the gift committee and for thoughts about the size of a goal for the campaign. The following is a direct quote: "Our 40th Reunion is truly the 'Big Event.' With the passage of 40 years, some of us have retired, others are at the zenith of our careers, others are still paying for the education of children, and others are planning for retirement. Let this letter trigger your thoughts and motivate your actions to participate in a unique challenge. The time is now when each of us, to his own conviction and maximum capacity, can make his first, his continuing or his final major gift to M.I.T."

Bob Ormiston retired from AT&T Communications and has been busy setting up as a communications network consultant. Bob has been involved in transmission and switching network development. Bob observes that there are many losers in the breakup of AT&T but the breakup makes the role of consultants more important in helping customers of communication services.

Norm Kreisman is still wearing the technology transfer hat at Department of Energy but he is also the executive secretary of the White House Federal Coordinating Council in Scientific, Engineering and Technology (FCCSET) committee on advanced scientific computing (supercomputers). Recently he was in Paris on a Smithsonian tour. His wife, Gloria, was with him in Paris. Norm sent some suggestions about a project for our 40th Reunion Gift Campaign.

Mark Kirchner was named a fellow of the American Institute of Aeronautics and Astronautics for his many original contributions to higher standards of safety, excellent handling qualities and accuracy in performance prediction of commercial transports. Mark is director of Engineering Technology with Boeing Commercial Airplane Co.

Norman Hobbs died in October, 1984. Norman was an authority on the effects of nuclear weapons. Born in Melrose, Norman was a vice president of Kaman Sciences Corp. of Colorado Springs, Colo., and general manager and technical director of Kaman AviDyne, a Burlington company he helped form in 1956. His main interests were in researching structures, aeroelasticity, aerodynamics, guidance and control systems and instrumentation. From 1949 to 1958, he conducted research at the M.I.T. Aeroelastic and Structural Research Laboratory. Also, he participated in several atomic test operations between 1951 and 1955 while serving as a research officer in the air force. From 1958 to 1964, Norman was president of AviDyne. Research programs carried out under his supervision included studies on the effects of atomic weapons on aircraft. Our class sends our sympathy to his wife, Barbara, six children, his mother, and his sister.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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The class of 1949 is proud of the public recognition of the accomplishments of **William C. Schneider,** who was recently elected to fellowship status by the select community of Fellows of the American Institute of Aeronautics and Astronautics at the Institute's annual meeting in Washington, D.C. Bill was cited "in recognition of his dynamic leadership of space technology and development for over two decades and for the management and direction of major U.S. space programs." Congratulations. . . . New England Electric System elected new officers in their reorganization. Among them is **Robert Bigelow** of Southboro, Mass., who was elected vice president. Bigelow is a registered professional engineer who has served as the company's director of planning and power supply since 1973. Since 1981 Bigelow has also served as the president of New England Electric's international subsidiary. . . . **Bernard D. Steinberg** continues his work in high resolution microwave imaging. He is a professor of electrical engineering and the director of Valley Forge Research Center at the University of Pennsylvania in Philadelphia. Recently he authored a book, *Microwave Imaging With Large Antenna Arrays*, which was published by John Wiley and Sons.

We regret to announce the deaths of several classmates. **Lynn Worley** of Vian, Okla. died last fall, and **Eugene Morgan** of Bedford, N.H. passed away in March. . . . **William Haddon, Jr.** of Bethesda, Md. died in March also. Haddon was a nationally recognized authority on highway safety. A physician, Dr. Haddon worked to reduce deaths and injuries on our nations's highways. He had an illustrious stewardship in research and medicine devoted to highway safety. Dr. Haddon served as director of the National Traffic Safety Agency and as president of the Insurance Institute for Highway Safety and the related Highway Loss Data Institute. He was the recipient of many public service awards including the American Public Health Association's Bronfman Prize for Public Health Achievement and the Modern Medicine Distinguished Achievement Award.

Your class secretary is hopeful that the June mini-reunion of the classes of '47, '48, and '49 in Newport R.I. will be a fertile source of class news. Our 40th Gift Reunion Committee will have also met at this time to organize efforts to make our contribution to the Institute a significant one. You will be hearing from the chairman, **Tom Toohy,** or from a committee member about this effort.—**Barbara Feeney Powers,** Secretary, 39 Mt. Vernon St., West Roxbury, MA 02132, (617) 323-1539

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James W. Hart is president of Hartech, Inc., consulting engineers, designing microwave and two-way radio systems. Jim is also performing technical trade off studies for telecommunications. Hart's been married 28 years, and the last of his three children graduates from college in June. . . . **Charles A. Whitney** recently lectured at the Metropolitan Museum of Art on the astronomy of Van Gogh's "Starry Night." He also won Byte's "Bomb" prize for the article of the month in October 1984 on the subject of random number generation. . . . **George B. Duhnkrack** was recently named president of U.S. Technology Corp., a wholly owned subsidiary of U.S. Plastic and Chemical Corp. He started his career with U.S. Plastic in 1957 following a number of years at American Cyanamid and graduate work at Princeton. George is married, has one daughter, and lives in Maple Circle, Brooklyn.—**Gregor J. Gentleman**, Secretary, 600 Holcomb, Suite 1, Des Moines, IA 50313

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Keith L. Daly '85, of Melrose, Mass., is the first Class of 1952 Scholar. As faithful readers will recall, a long-misplaced gift to the Alumni Association, consisting of the dividends of some life insurance policies, has been used to start a scholarship fund to which we are all encouraged to make additional contributions. To promote our involvement, descendants of class members are given priority, assuming they are in need and otherwise qualified. Since our class is fortunate enough currently to have no undergraduate descendants who are both smart and poor, we have, so to speak, adopted Mr. Daly, a student of mechanical engineering and an outstanding young man of whom we and M.I.T. may be proud. In a letter of thanks to class president **Art Turner**, Mr. Daly writes:

"I am honored to be the first recipient of the Class of 1952 Scholarship. My years at M.I.T. have been very rewarding. Your class has helped to make this possible.

"To help support myself, I have worked in M.I.T.'s Undergraduate Research Opportunities Program (UROP) for the past three years. This be-

gan as a necessary means to earn money, but ended up becoming my most fulfilling activity at M.I.T. Having completed my thesis, I am currently doing public relations work for the UROP program. Through a professor I met in my research laboratory, I have secured a position in Digital Equipment Corp. I'll begin on July 15 as a mechanical design engineer.

"Alone, I did not have the resources to attend M.I.T. With your generous scholarship I will be able to graduate with my class next month. This letter is not thanks enough. Instead I must thank you by working hard and sharing the rewards of my success with others in need of support."

A reward for success has come to **Ernest A. Grunfeld III**, who has been advanced to the College of Fellows of the American Institute of Architects. He shares some of the rewards of his success, in part, by active participation in community and professional affairs. His firm, Grunsfeld and Associates, is located in Chicago. . . . Working hard has also brought some success to **Dirk Plummer**, who has recently received an M.S. in electronic engineering from Monmouth College, West Long Branch, N.J.

Dr. **Charles Beckmann** has retired from the air force as a colonel, and started a private practice of cardiology in San Antonio, Tex.

Sergej Zezulin, of Sea Cliff, N.Y., the president of a construction firm, died last Februuary 2, 1985. He is survived by his wife and a daughter, Lena, of Tacoma Park, Md.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

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Recently we received brief notes from two our our classmates who became presidents. **Richard E. Storey** writes that he is now president of the Los Angeles chapter of the International Society of Air Safety Investigators, while **Joseph B. Banks** says he recently became president (and majority stockholder) of Pocono Downs Raceway where harness racing is held. Congratulations and best wishes to you both. **Joe Banks** also operates the Odyssey Fitness Center in Wilkes-Barre, Pa. and a roller skating center in Kingston, Pa. To quote Joe, "You never know where civil engineering will lead you!"—**Wolf Haberman**, Secretary, 41 Crestwood Dr., Framingham, MA 01701; **Joseph M. Cahn**, Assistant Secretary, 289 Bronwood Ave., Los Angeles, CA 90049

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Perry Smoot writes that he is with the Army Materials and Mechanics Research Center in Watertown, Mass., where he continues to develop metal matrix composites for ordnance application. His son Peter, '85, has been admitted to the Course VI-A graduate program at M.I.T. . . . From **Steve Poulos** comes word that his firm, Geotechnical Engineers, Inc., of Winchester, Mass., and E.I. Robinsky Associates of Toronto were jointly given the Grand Conceptor Award in Category A, Consulting Engineering Services. The recognition is for their project, "Earthquake Resistant Mine Tailings Disposal." Steve and his associates had to introduce new laboratory and analytical procedures based on the principle of steady state deformation in order to complete the study. . . . **Dave Myers** informs us that he is currently a senior product engineer at Wang Laboratories in Lowell, Mass.

Why not start the new academic year by letting us know what you are doing?—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.**, Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

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From **Alexander H. Rose**, we receive the news that he has formed his own firm, A.H. Rose, Inc., specializing in construction management, real estate development, and general contracting. Early this year A.H. Rose, Inc. signed a construction management agreement for a multimillion dollar hotel and conference center to be built in Essex, Vt. . . . **Philip A. Trussell** has been promoted to director of real estate and associate treasurer of M.I.T. Philip, who has been M.I.T.'s senior real estate officer since 1977 and director of real estate and assistant treasurer since 1983, will continue his responsibilities for the management, development, and administration of M.I.T.'s investment real estate. Before coming to M.I.T., Philip was a project director for Cabot, Cabot, & Forbes Co. He was responsible for a major shopping mall in Austin, Tex., a significant portion of the development of Technology Square, and for parking garages at Massachusetts General Hospital and Tufts-New England Medical Center.—**Robert Kaiser**, Eastern Co-Secretary, 12 Glengarry, Winchester, MA 01890, (617) 729-5345; **Caroline D. Chihoski**, Western Co-Secretary, 2116 W. Davies Ave., Littleton, CO 80120, (303) 794-5818

War in the heavens or peace on earth? Media coverage and public reaction have ranged between these extremes on President Reagan's Star Wars defense program. Lieutenant General James Abrahamson, '55, director of the Pentagon's Strategic Defense Initiative Organization, says that press coverage on the whole has been quite fair in examining the Star Wars plan and its arms control implications. Featured in the June 17, 1985 issue of* Newsweek, *Abrahamson advocates frankness on the subject.

Abrahamson's Hope for Peace

"We should use technology to help us, but in the end a human solution is the final solution," Lieutenant General James Abrahamson, '55, concluded in his address to the World Affairs Council of Boston last June 11. As head of the Strategic Defense Initiative, it's his job to conduct a research program to find a defense against ballistic missiles of all ranges and to assure that it's affordable and survivable. And although such a defense system presents some very big challenges, Abrahamson claims that incredible progress is being made—nearly 800 contracts are out, signed, and being worked. Universities will be playing a part in this research, he says.

Abrahamson emphasizes that Star Wars represents a fundamental re-evaluation of the way the U.S. has tried to maintain the security of the West. Instead of the retaliation principle, the program focuses on saving lives rather than avenging them. "If we can make missiles ineffective, we take away the military value of the missiles and are in a more negotiable position," he points out. "None of us feel we should abandon attempts at arms control."—*Sandra Knight* □

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Does September still seem like the start of the year to you? Well, that's the price you pay for all those years at the Institute—and for all those kids you've got in college! Just to start your year off right, here's the latest news on the class of '58. We received a note from **Frederic Davis,** who is now professor and chairman of the mathematics department at the U.S. Naval Academy in Annapolis. Fred and his wife, Cathy, have two daughters, both of whom are at Cornell University. Continuing the family tradition, Cynthia (20) is a junior and a math major, while Elizabeth (18) is a freshman in pre-med. . . . **Neal Jeffries** is the founder and executive director of the Center for Manufacturing Technology in Cincinnati. This organization is a non-profit educational center that seeks to address the rising importance of automation in U.S. industry. . . . **Walter Wollny** has formed a consulting engineering firm, Quick Reaction Corp., specializing in the environmental effects of radar systems. Currently, the company is recruiting electromagnetic specialists to add to its growing staff. Previously, Walter was a systems engineer at Lockheed Missile and Space Co. in Sunnyvale.

Dick Barone is now on the faculty of the College of Engineering at Boston University. . . . In Dayton, **Bill Austin** is at Wright-Patterson Air Force Base where he is an engineering manager for the aeronautical systems division. He and Mary have five children ranging in age from 15-24. . . . Another entrepreneur in the class is **Malcolm Green** who has been involved in the start-up of four companies. Currently, he is executive vice-president of Emulex Corp. in Costa Mesa.

Mal and Martha have four children but still have time to be active in community and professional organizations.

Wide-awake night owls in the class may have caught the ABC *Nightline* show on March 15 in which **Ken Whipple,** an executive at Ford Motor Co., was interviewed by Sander Vanocur. Ken, is president of Ford Motor Credit Co., appeared on the program with Joji Akai of the Japan Productivity Center and David Davis, editor of *Car and Driver* magazine. As a viewer, I thought Ken presented very effectively the technology and design improvements that Detroit had made in response to the Japanese automotive import challenge. . . . Down in the Philadelphia area, **Gary Blakley** is the controller and assistant treasurer of Scan-Data Corp. Gary and Marilynne have a boy and a girl, both teenagers. . . . **Harold Samuels** is with a consulting firm, Computell, Inc. in New York City, and he also serves as president of Advertising Data Processing. He received his M.B.A. from Columbia University and also did post graduate work at Princeton. Sandra and Harold have three children, Scott (22), Stephen (20) and Sherri (15). . . . Hope your summer was restful and relaxing and that you're ready to start the new year.—**Michael E. Brose,** Secretary, 59 Rutland Sq., Boston, MA 02118

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There are increasingly frequent meetings of local '61ers to get moving on our 25th Reunion. As of last May the plans were to base things on campus but to have various functions at interesting places around Boston. There is some thought of having a major dinner or dance in the atrium of the Kennedy Library. Even you Kennedy haters will like this spot overlooking Boston Harbor and surrounded by fascinating memorabilia from the years just after graduation. The class gift committee has decided to give a lot of money to students in the form of a Class of '61 scholarship fund. God knows the students will need it with Institute tuition climbing about $10k these days.

It might be a good time for you to think about coming to Cambridge next spring. I am getting in touch with classmates from Senior house and will try to get us all together to compare hair and waistlines. We can go back and look at our old haunts. My students tell me the old place is now all "sex, drugs and rock-and-roll." We shall see. You might want to look up old friends, too. I can get the alumni office to print out a list of people from your living group and have it sent to you. Just let me know.

A note from **Roy Chin** came the other day in which he said that since leaving the Louisiana Land & Exploration Co. he has done a couple of refinery assignments for the World Bank. While in Burma on one of these jaunts he found out the World Bank is in need of other European based consultants qualified to do country energy assessments. If any of you qualifies, get in touch with Roy at 100 Pineland Dr., Mandeville, La. 70448. Sounds like interesting work.

I got a nice letter from **John Baxter** written on what seems to be a MacIntosh. It looks very fancy indeed. He wrote "Once again I am engaged in one of 'my non-standard' ex-M.I.T.-student pursuits. Since early October, 1984 I have been working as a volunteer (read: 'unpaid') deckhand on the sailing vessel *Californian*. The *Californian* is a newly-built (launched May 29, 1984) 145-foot topsail schooner. Her mission is sail training for the youth of California. *Californian* is operated by the private, non-profit, Nautical Heritage Society of Dana Point, Calif. She has been declared California's official tall-ship ambassador by legislative resolution, but otherwise has no state connection. I became involved as I walked past the San Diego construction site regularly on my way to work as a deckhand on the 62-foot yawl *Jada*. I made a donation to the project which entitled me to make a portion of the ship's maiden voyage (in my case, Monterrey to Oxnard, Calif.). During our layover in Port San Luis, I signed on as crew for a two-day sail, due to illness among the regular crew, and my involvement grew from there. I expect to stay involved—not quite full time—until they realize I don't know anything, but by the time this is printed, I should have made it onto the fore top yard for sail furling work. I am approaching that venture with caution: falls onto a wood deck from 70 feet hurt! Those who remember me will recall that I did not take part in sailing while at M.I.T. I guess we all made mistakes of one sort or another! Coupled with my one year as an umpire in the Class A Florida State League, I would think that my current (unpaid) work may qualify me for the class odd-ball occupation championship. Former associates in computer programming keep threatening me with 'real' work, but I have resisted for the past several years." Thanks for the wonderful letter John.

The *New York Times* ran a nice review of **Richard Meehan**'s new book, *The Atom ad The Fault: Experts, Earthquakes and Nuclear Power* a couple of months ago. The book contends that the recent problems in the nuclear industry are due to the "experts" who don't seem to be able to agree on anything. Everyone with an advanced degree seems to be equally responsible: the geologists, the lawyers, and the engineers all get theirs in the book. Its $13.95 and 161 pages long from the M.I.T. press.

We lost a Dean but gained a Provost last February. **John Deutch**, who was M.I.T.'s dean of science moved up a notch and now is in charge of things like space assignment. This interests everyone at M.I.T. and I'm sure he will suddenly get a whole group of new friends. That leaves the class with only one M.I.T. Dean: **Gerry Wilson**, Dean of Engineering.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

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Personal computers, with their associated programs, peripherals and networks, enable us increasingly to lead solipsistic lives. It is now possible, with PCs, VCRs, and CDs, to conduct a business or profession, then be entertained without leaving a single room. The tangible presence of other human beings becomes decreasingly necessary for social intercourse. But is it necessary for well-being? For survival?

We members of '63 were born for the most part during World War II. We were educated and trained just before the electronic transformation of American culture (although many of us helped bring it about). We left M.I.T. just before the social upheavals of the sixties and early seventies (but may later have taken part). So we arrived just before the cusp, giving us—I think—a unique perspective on the changes that have occurred, and from which to predict those that will occur in the rest of our lifetimes. Surely we have all thought about these things, and I would be pleased to print any brief comments you may have to share with classmates.

There is some news, although less than I would like to have (so please write). **John Cheney** is a partner in Cheney/Page Architects, of Mount Vernon, Wash. He is 1985 president of the Northwest Washington chapter of the American Institute of Architects. . . . **Carl Dover** has been a visiting professor at the University of Paris, Sept. '83 to June '84, and Spring '85; he is also involved in research to theoretical nuclear physics at Brookhaven National Lab, where he is a senior scientist. . . . **Thomas Sheriff** is an attorney with Exxon, involved in international crude-oil transactions. . . . And lastly, I have an indirect report on **Steve Swerling**. He is vice-president of Mentor Graphics of Portland, Ore., of which he is a founder. Steve left Tektronix to go to Mentor, but before he left he got Tektronix involved with VI-A program.

You folks with more mundane activities have been falling off on the job of reporting them, leading the casual observer to intuit we are all obviously hotshots.—**Phil Marcus**, Secretary, 2617 Guilford Ave., Baltimore, MD 21218

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As I write, it is April; as you read, it is August. I hope your summer season is going well.

The envelope from the Alumni Association brought a few items this month. Sad to say, there has been a tremendous lack of mail sent directly from you to me with news of your activities. Try sending a note; top billing in the next column is guaranteed.

From an Alumni Fund contribution card comes news from **John Meriwether** that he has been busy traveling in connection with his position as a research scientist at the University of Michigan Space Physics Research Lab. Thus far in 1985, John has been to Greenland, Peru, Norway, Czechoslovakia and Utah. He writes that he never expected this when he thought of being a scientist. John also notes that he very much enjoyed our 20th Class Reunion. According to my calculations, John must have already logged enough frequent flyer bonus miles to have earned a free trip from Ann Arbor to Cambridge for our 25th Reunion—which is less than four years away, folks!

A short Alumni Fund note from **Bob Gray** who is a professor at Stanford University. A year ago he became director of Stanford's Information Systems Laboratory. In addition, he received the Centennial Medal from the IEEE. I don't remember precisely how many people were honored by the IEEE on the occasion of its 100th anniversary but it was not a large number. Congratulations, Bob! Were there any others in the Class of '64—if so, please write.

A note on style: the Alumni Fund card lists Bob as Robert M. Gray. I will admit that I did not, and do not, know Bob personally but it seems as though he ought to be a Bob, rather than a Robert. For your information, I will probably be using the more familiar name where there's an option. Of course, if you make a specific note on your Alumni Fund card about your preference, I'll comply.

Don Silversmith has moved from Boston to Washington to serve as program director of solid-state and microstructures engineering at the National Science Foundation. He has taken a two-year leave of absence from Lincoln Lab to serve at NSF. However, Don plans to be back in Boston to help with our 25th Reunion in his role as class vice-president.

The M.I.T. news clipping service provided the next two items. **Steve Kraysler** has moved up another step in his career. Effective March 1, 1985, he became president and chief executive officer of the John Hancock Property and Casualty Insurance Companies, a subsidiary of the John Hancock Mutual Life Insurance Co. Steve has been with the Hancock since graduation from the Institute. He lives in Norwell with his wife, Edith, and two children, Coreen and Kathryn. I have noticed that over the last several months, the light on top of the "lesser Hancock building" has been a more accurate weather predictor. Could it be that the technological influence of the Class of '64 is having a positive effect at the Hancock?

The *Boston Globe* of January 24, 1985 contained an interesting article on **David Judelson**, a "ceramic artist (who) tests concepts of spatial relationships." His recent work involves "playing around with how we see a two-dimensional surface representing a three-dimensional space." David has been concerned with public art projects which allow him to operate on a large scale. One such is a 300-ft. mural on the East Cambridge parking facility. The *Globe*'s writer also took particular note of one of David's projects—an exterior wooden staircase for a two-family house in Medford. Ah, the influence of the Baker House stairs must have been felt on everyone at M.I.T. not just the Bakerites.

One more item. Your Class Secretary celebrated

National Secretary's Week by having lunch with a classmate, **Gary Walpert**. Gary continues to practice patent law as a partner with the firm of Lahive and Cockfield in Boston. He, his wife Ellen, and their three children (Tara, Ellen and Kirsten) live in Weston and are staying very busy. The Walpert daughters have become quite proficient at ice skating and swimming and are also very charming young ladies. Gary and Ellen have extended their gracious hospitality to me a number of times over the past several years—nice people!

Please send a note describing your activities, views on world affairs, or whatever.—**Joe Kasper**, Secretary, c/o TASC, 8301 Greensboro Dr., McLean, VA 22102

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It seems to be spring and the envelope brought a relatively bountiful harvest of Fund envelopes with news of classmates far and wide. . . . **John Edgar**, a colonel in the Air Force, has returned to the Boston area and is now assigned to the electronic systems division at Hanscom AFB in Bedford. John is "dual-hatted" as the director of command management systems and as program manager for the Local On-Line Network System (LONS)—a standard office automation system being developed for use within the Air Force Systems Command. . . . **Jim Chang** has joined Arthur Young and Co. as a principal in the management consulting practice. Jim will be specializing in marketing, product planning, strategic and business planning for the financial services industry. . . . **George Lee** reports that he is still self-employed and writing software for personal computers—right now mostly the Apple MacIntosh. George says that he loves the work and the freedom. . . . **Steve Gray** recently joined the Cornell University Laboratory for Nuclear Studies as as senior research associate.

Steve Roth continues to teach physics at John Jay College in Manhattan. Steve, wife Margaret, and their two daughters also live in Manhattan. . . . **Jim Breedlove** is working as a group leader in computer systems in the North American exploration department of Conoco. Jim and Nancy were married in 1967, and have three daughters aged 13, 11, and 6. Nancy works as a reporter. . . . **Vinod Jhunjhunwala** says that his import-export business is exciting and offers the opportunity to travel. Daughter Ranjini graduated from high school in June, and son Uday enters the seventh grade in September. . . . **Bill Chirolas** has completed his studies and examinations and been named an actuary by the Society of Actuaries. Bill is second vice-president and actuary with the United Services Life Insurance Co. of Washington. Bill lives in Annandale, Va., with his wife and three daughters.

On the personal news front, **Walter Miller** writes that, after prolonged bachelorhood, he succumbed to the wiles of his bride Synthia H. Mellon, Ph.D., and they were married in San Francisco last November 24. Walt is presently associate professor of pediatrics at the University of California, San Francisco. He reports that he has finally succeeded in cloning the gene for 21-hydroxylase, an enzyme disorder in one in 5,000 persons. . . . **Mike Hester** proudly writes that he ran his first marathon (Long Beach) in February of 1985 and finished in 3:58.

Not such a bad collection. I wonder who will be doing this in six months, someone new or your faithful servant.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

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Don and **Lucille Hodges** have a new baby girl, Pearl Annie, born September 24, 1984. . . . **Bruce Watne** is an assistant professor of chemistry and astronomy at Northwest Community College in Powell, Wyo. . . . **Fred Goldman** recently saw a familiar face on a flight from Toronto to Boston. Upon investigation, the face turned out to be that of **Cliff Lawrence**, who moved from Calgary to the Boston area a few months ago. Cliff is with Swanson Energy Group, Inc. and provides energy related consulting services. . . . **Greg Zacharias** is the proud owner of Charles River Analytics, which has been in business for more than one year. He and Susan live in Weston, Mass. with their two boys, Owen and Evan, ages 5 and 2 1/2.

Arnold Lieberman writes that after almost three years on social security disability he is now employed at the H.W. Wilson Co. as a systems programmer responsible for system maintenance, teleprocessing software, and communications hardware. . . . **Joe Deichman** is director of finance and program control for the Space Station Systems Division of Rockwell International. . . . **Richard Cunningham,** a Connecticut state representative and practicing attorney, writes that his ninth child was born in April. He has five girls and four boys.—**Jim Swanson,** Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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Greetings again from the shores of the Potomac. We have news this month from the home team. Gail left the Congressional Research Service at the end of May to join the Nuclear Regulatory Commission as director of the policy, planning, and control staff in the Office of Nuclear Regulatory Research. In this capacity she will help plan and coordinate a research program involving over 200 people and 120 megabucks. So for the time being we will have two regulators in the family. . . . We have two births to report: Ruth and **Brooks Hilliard** report the birth of Beth Rachel, their second daughter, on December 4, 1984. Brooks notes that he has recently written a book, *Buying a Computer for Your Growing Business: An Insider's Guide* (Don Jones-Irwin). . . . Rebecca and **Winston Gardner** are the proud parents of Alexandra who was born on March 27, 1985, and joins her brother Myles who is now 3. Winston joined Mobil Oil after graduation and is now light products technical service manager. Rebecca and he are in the process of adding a wing to their 180-year-old home in Furlong, PA.

Barry Mitnick still tells people that he teaches at University of Pittsburgh, but actually Margy and he spend all their time taking care of three "extremely good looking (even to us)" children: Jenny and Jeff (4 1/2) and Michael, all-American climber and fast talker, 2. . . . After receiving a Ph. D. in solid state physics at Berkeley in 1973 **Jeff Stokes** joined IRT Corp., San Diego. He plays ice hockey at least twice a week, is father of "two purrfect kittens," Darvey and Dudley, and has been the husband of Bonnie L. Spector for the last 12 years ("that should be some sort of record").

From sunny California we hear that **Shan Cretin** is at University of California, Los Angeles, while her husband, Emmett Keeler is at RAND. Shan is involved in a variety of research projects for the Health Care Financing Administration on Medicare hospital payment policies. Still in the embryonic stage is some research with the Chinese government on health care financing and access in rural areas. She's been studying Chinese for a year now and has made two trips since September 1984. Their oldest daughter, Mikala, is a sophomore in high school and daughters Lauren and Alexis are in second grade and kindergarten, respectively. She adds "None of the kids are particularly charmed by my China travels. Emmett takes things in stride, however, and I am a bit disconcerted to learn how dispensable I am.". . . **Aviva Brecher** spent 1983-84 as a Congressional Scientist for the APS with with Senator Paul Tsongas in Washington. Her husband, Ken, spent the year at NASA as a senior NRC fellow and their two kids joined the fun. She has been elected to the Executive Committee of the Forum on Physics and Society and plans to stay involved in policy. . . . That's all we have for this month. Hope you all have a good summer and write us about what's new.—**Gail** and **Mike Marcus,** Secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

69

These notes are necessarily brief. We have just moved into our new home in Virginia and I have started work as a science writer/broadcaster for the Voice of America. We are surrounded by a million unopened boxes and have mild cases of culture shock.

Shelly Fleet writes: "Loved the reunion. Hilary was born four and one-half weeks after the reunion on July 16. (By the way, Shelly, the 15th anniversary of the Apollo 11 launch.) Her brothers Brad and Andrew love her. See you all in four and one-half years." . . . **Robert Gentala** reports that he is service manager at Beaudry's Mercedes-Honda in Tucson and is also owner of Easy Way Computers, computer leasing.

John Merrill is still working at the Lawrence Livermore National Labs in their biomedical division designing biological research instrumention. John recently earned a black belt in Jujitsu, a Japanese martial art. . . . **Sandra Lee Harris** (formerly **Mathes**) is a computer consultant in Washington. She has returned to competitive fencing (foil and epee) with Olde Towne Fencing Club in Alexandria, Va., and has two sons, Andy (11) and Ben (8). . . . Until I catch my breath and undo the entropy explosion, I'd best close.—**Eugene F. Mallove**, Secretary, 11902 Paradise Ln., Herndon, VA 22071. (The mailing address for some reason is Herndon, but we really live in Oakton near Fairfax. You figure out these crazy Southern ways!)

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Joseph Baron is involved in manufacturing processes and is interested in reviewing a patented or patent-pending product for manufacture . . . . **Philip Dorin** is chairman of the electrical engineering computer science department at Loyola Mariemont University in Los Angeles. . . . **Laurie Nisonoff** is an associate professor at Hampshire College. . . . **Paul Guaraldi** is a principal/partner in a real estate development firm specializing in industrial, commercial, and office buildings throughout the nation.

Anthony Picardi joined Cortex, Inc. in Waltham as a senior product manager. The company produces a software tool that automatically generates business systems from given specifications. He and his wife have traveled extensively, and she recently has taken on the job as bursar. . . . **Reid Ashe**, chairman and chief executive officer of Viewdata Corp. of America in Miami Beach has been nominated as a member of the jury that awards the Pulitzer Prizes in journalism.

Wesley Moore wrote a note for the class secretary. He and his wife recently had their first son and second child. He writes that **Marc Weinberg** designs and tests instruments at Draper Labs and was a visiting scientist with North Norwegian Science Foundation; **Jim Van Gaasbeek** has started to build helicopters for Messerschmitt in Mueling, Germany, while his spouse does a stint with the United States Tax Court in the District of Columbia; and **Dave Hall** is at the Albert Einstein facility and is involved in some environmental work.—**Robert Vegeler**, Secretary, Dumas, Backs, Salin, and Vegeler, 2120 Ft. Wayne National Bank Bldg., Ft. Wayne, IN 46802

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Al Solish writes: "I'm in private practice, opthalmology, in Los Angeles with another office in Beverly Hills, both on Wilshire Blvd. Peg, '72, is still at JPL. Ben is 2 1/2 and is looking forward to a little brother in April. I'm still running in ultra-

marathons. I finished the Western States 100 miler in 21:07 in July. I'm looking to improve on that this year." . . . **Chuck Williams** is executive vice-president of McBride Ratcliff and Associates in Houston. His firm is a group of geotechnical engineers. He and his wife have three children, ages 11, 7, and 4. . . . **Jim Shields** and his wife, Gayle Merling, announce the birth of their first child, Michael James Shields.

Robert D. Horner and his wife, Rita, have two children, Robby and Lit'le Rita. . . . **Edward M. Donie** was recently promoted to controller, Information Systems Division, Data General Corp. . . . **Mitchell I. Serota** married Barbara Wurman last September 16. Jean and **Hugh Masterman** attended. . . . **Jacqueline T. Whitney** has been teaching physics in Pittsburg for the past few years. On November 10, 1984 she married Eugene W. Siren, a computer analyst. They are expecting their first child in August.

Robert F. Bennett, Jr. writes: "Since I left M.I.T. I've worked for Oak Ridge National Lab in Tennessee, Flour, E&C in Houston, Tex. and CBA Co., a small HVAC equipment sales firm in Denver. At this time I'm selling industrial and process equipment and controls for Brock, Easley, Inc. in Denver. My wife Anne is from Bozeman, Mont. We have one daughter, Laura, 3. Ex Burton House and MacGregor folks should know that Richie Reavis is currently down with pneumonia although he is better now. I am sure he would like to hear from his friends."—**Hal Moorman**, Secretary, Box 1808, Brenham, TX 77833

73

Greetings from mint julep land. As Ah set heah on the veranda, pondrin' things, Ah see some mail from the troops.

Doug Mink has left the Institute for a new job at the Harvard Smithsonian Center for Astrophysics. He is writing software for data from an infrared telescope due to fly on Skylab. He is also riding his bike heavily and into a group he describes as an "AAA for touring bicyclists in Mass." . . . **Peter Stiller** was recently promoted to associate professor in math at Texas A & M. . . . **Radia Perlman** is working as a network architect for Digital. She and hubby Mike have produced Dawn ('02) and Ray ('05).

This month, I though for a diversion I would group unrelated people rather than clumping doctors, fathers of multiple children and Shuttle pilots together in the same paragraph. Send your editorial criticisms to this address.

David Ashley is now associate professor in civil engineering at Texas-Austin, after receiving the NSF Presidential Young Investigator Award for five years of research support. David also married wife Anna in September. It seems worthwhile to note that a contemporary of mine is getting a "young" anything award. I say that because I am 34 today. . . . **Steve Strauss** is in a Ph.D. program in operations research at Colorado School of Mines. . . . **Howard Brodie** breaks away from son Frank periodically to involve himself in his work, which currently includes AIDS research. . . . **John Caesar** is involved in fatty acid and enzyme analysis at Beth Israel, shuttling between there and Mass. General Hospital's pigmented lesion clinic, Harvard Med and Tufts Nutrition Center. Send your unwashed toenail samples to John c/o Technology Review. . . . As for me, Ruth, Eric and Jr, well, we have a little Bulgarian man stuccoing the sides of our home to give it something close to its final look. I promised you a picture, and you all will get it, but not just yet. Our family DP shop is still humming along, and my new tractor has been put to extremely heavy use. Still, we don't have a home computer though. Ruth and I just finished our third winter bowling up in Manassas, and yours keglerily finally won the average title with an even 180 and my most ever 600 series (six in 33 weeks). If you don't care to hear more of my bowling exploits, we'll just have to have other stuff to put in here, like you're letters—hint, hint!! P.S.—the Life Savers leave Friday for Roanoke for the Mid-Atlantic (Southern Division) barbershop quartet championship. Tell you how it went next time, if we did well. Write!!!—**Robert M.O. Sutton, Sr.**, Secretary, "Chapel Hill", 1302 Churchill Ct., Marshall, VA 22115

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I was saddened to learn of the death of our classmate **Omer S. Kaymakcalan**, a physicist at Syracuse University, on February 22, 1985. He had been ill with leukemia.—**Alex Castaldo**, Secretary, 929 Mass. Ave., Cambridge, MA 02139

76

My apologies for having no column for the May/June issue. Your secretary got crunched for time. I will try not to let it happen again. . . . The mails have been kind. From **Olimpio de Marco**: "Continuing to spend long, enjoyable days at Computervision as a product marketing manager for mechanical design and analysis (CAD/CAE) products. Recently visited Japan to train the sales force and talk to customers like Pioneer, Honda, and Toyota. Got some good shots of Mt. Fuji from the bullet train traveling at 250 kilometers per hour. The Japanese seem to do everything efficiently, from waiting in line at train stations to designing and manufacturing these high-speed but very comfortable trains. A new law in Tokyo requires all night spots to close at midnight, but I had plenty of opportunities earlier in the evenings to experience sushi, sashimi, broiled eel, barbequed whale meat, and other delicacies all washed own with Sapporo draught beer—I didn't like the sake! The Japanese drivers rival Boston's 'best.' I now understand why most Japanese commute by train. . . . **Tomas Moran** is working on design and implementation of laboratory information systems at Stanford Hospital, while his wife, Susan Tonik, is doing research in cancer detection at Stanford University."

David Stork writes, "I leave Swarthmore College faculty to become assistant professor of physics and adjunct assistant professor of neuroscience at Clark University in Worcester, Mass. I look forward to being close to Cambridge and Cape Cod." . . . **Michael McNamee** writes, "Just changed jobs. After two and one-half years at the Money Section of *USA Today*—yes, 'the nation's newspaper'—I'm becoming the Washington economics correspondent at the *Dallas Morning News*. Promises to be wonderful fun, even though my parents and friends won't be able to read my stories." . . . We have a change of address notice: "Diane and **Bob Rosenchein** and Avi, Dov, and new son Akiva are happily settled in Jerusalem, Israel." Congrats. It is a long move. . . . Rita and I had the pleasure of hosting **Dan Dershowitz,** Debbie Gross, '78, and son Michael for brunch. Dan remains busy at Halcyon doing chemical engineering research, Debbie is at General Foods, and son Michael is now over 3 months old.

It amazes me how fast the time has gone. Can you believe that less than one year from when you read this we will be having our *10th REUNION*! Has it really been that long, nine years now since we got our undergraduate degrees? For my part, mentally the answer is no, it doesn't feel like it. But judging from the grey hairs I have gotten from trading futures and other adventures, the answer must be yes. It has been a busy and tumultous time, both professionally and personally. I presume that for many of you, it has been the same way, perhaps not in degree but certainly in essence. To quote Seneca: "*O tempora, o mores.*" And I still believe that we are still in the midst of radical, and possibly violent social, economic, and political changes.

Insofar as what I have been up to, I may have found a new business outside futures. If it does indeed get moving, you will hear about it! Otherwise, I am continuing to do consulting and am currently almost buried in projects. As for the markets, we had an impressive short squeeze and blow out in cocoa. Sugar has hit 15-year lows, bonds do have more fun, and the dollar continues to be a very violent arena for both bulls and bears. Plus, the stock market, via index futures, remains a very exciting place. Nothing like a few thirties style bank runs to liven up the trading day and the evening news! Am I callous about the bank failures? As a future trader, of course—they help make my markets move. Traders are like sharks; without movement, they drown and die. Movement, change, that is the stuff and basis of breathing and life. . . . Please do write—we desperately need more news!—**Arthur J. Carp,** 110-07 73rd Rd., Forest Hills, NY 11375

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I am saddened to report the death of **Wayne E. Matson** in March of this year. Wayne's death was reported by a fraternity brother, Richard Breed, '73.

Dr. **Richard Ulene** is now in his second year of residency in internal medicine at UCI Medical Center. Richard is also consulting in medical electronics and computing. . . . **Mary Fogg** (nee Schaeffer) graduated from Harvard Business School in June 1984 and is now working as a management consultant for Bain and Co. in Boston. Mary and her husband, Harold, have bought a contemporary house across the street from the ocean in Marblehead. . . . **Wendy Irving** passed the architectural exam in June 1984 and is now a registered architect in Colorado and a member of the AIA. Wendy bought a house in April 1985, and is busy fixing it up and "solarizing" it.

Humberto Rodriguez, Jr., has been busy with his new son, Daniel, and managing a group doing operating system software at Prime Computer. . . . Dr. **Libby Cone** will be starting a radiology residence in July 1986. She and David Iwatsuki, '76, have bought a house in Upton. Libby hopes that the next year will bring a chance to be in Japan. . . . Dr. **Douglas Feinstein** received a Ph.D. in biochemistry from Johns Hopkins University in April 1984. Douglas will be doing a post-doctoral fellowship in molecular neurobiology at the Scripps Research Clinic in San Diego this fall.

Richard Saunders and his wife, Eileen, announced the birth of their first child, Matthew Eric. Richard and Eileen will be moving soon to New Rochelle, N.Y., where Richard will begin a pulmonary fellowship at Westchester County Medical Center. . . . A long chatty letter from **Dan Ludington** tells of his various adventures and travels in the last year, sometimes with his dog, Ned. Dan traveled to Niagra Falls, Philadelphia, Phoenix, Grand Canyon, Colorado, New Orleans, and Pittsburgh, staying with **James Patesh** and his wife. James is working as a speciality chemical supplier to the steel industry. Dan's international travels included Morocco for three weeks, a month in Spain, and a few weeks in Scotland and England. Dan is currently living in Rye, N.H. and interested in discussing any of the following topics: "plasma chemistry, yogas, history and future of MOS fab. technology, macrobiotics, technology and ecology, the evolution of the new age, hitchhiking as a paradigm for cartography, etc." . . . Definitely the most-traveled alumni I've heard in a while.

That's all for now; drop me a line when you get a chance.—**Barbara Wilson Crane,** Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

79

Bob Drescher wrote recently from Santa Clara, Calif. Bob entered M.I.T. with our class, but graduated a year early. He couldn't drag himself away, though, and stuck around another four years, getting a master's in engineering in 1980

and a master's in management in 1982. With his array of degrees in hand, Bob worked for a year and a-half as a management consultant for McKinsey and Co. in Cleveland, Ohio. He then moved to Austin, Tex., where he joined ROLM to help start up their Desktop Products Division. He was the Production Manager when he received an offer last September to work for the president of ROLM, Ken Oshman, in Santa Clara. Says Bob, "I am currently the executive assistant to the president. To say that it has been a busy time would be an understatement. Since I moved to California, Ann and I had a little girl (Megan Elizabeths, born January 1, 1985, at 2:17 a.m.!) and ROLM merged with IBM! Now that I'm settling into life in California, I'd really appreciate hearing from any classmates in the Silicon Valley area."

Andrew Robinson got his Ph.D. at the 'Tute in June of 1984, and is now with General Electric Center for R&D in Schenectady, N.Y. Andrew and wife Dale are expecting their first child in September. . . . **Warren Manning** is in his junior year of residency in Boston at the Beth Israel Hospital. He writes, "I will be staying at the 'House of God' for my cardiology fellowship beginning July 1986. I will finally be out in the 'real world' looking for a job in June 1989!" . . . **Brian Peskin** is president of Ultra Wash, Inc., a national mobile truck fleet washing company with both franchises and company-owned locations. The company was featured in the January issue of *Venture* and the May issue of *Inc.*

Carol Schwartz is a registered architect currently working at Bergmeyer Associates in Boston and living in Cambridge. In October of last year, she married Steven Drucker (Harvard, GSD '80). . . . **Daniel Larner** works at Allen-Bradley Co. in Milwaukee, doing research in artificial intelligence, expert systems. His major focus has been on expert troubleshooting systems. . . . **John Kowalik** was married on September 1, 1984, to Michele Musgrove, a graduate of University of North Carolina, Chapel Hill. John was planning to start an M.B.A. program at the University of Chicago in June, after a month in Greece and Turkey.

Tom Tatrai has joined my department (Corporate Telecommunications) here at Mobil. Tom has been with Mobil's Northeast Computer Center near Princeton, N.J. (Pennington, to be exact) since 1979. He's still located there, but now reports to my boss and shows his face here a couple of times a week. Tom and wife Suellen, a special education teacher, have been married since 1982 and live in Lambertville, N.J.—but not for long. They recently bought 15 acres in Hopewell, also near Princeton. They designed a house which should be complete by the end of the year. Tom says they plan to do some farming out there as well.

That's all for now, folks. I've heard some intriguing rumors, and would love to hear from some of you so that I can print them in good conscience. Please write soon!—**Sharon Lowenheim,** Secretary, 303 E. 83 St., Apt. 24F, New York, NY 10028

80

Hello again, classmates. Though you are reading this column in the waning days of summer, it is only mid-May as I am writing it. Still ahead is our 5th reunion, which you have all undoubtedly attended.

Dirk Baars has stayed in the local area since graduating from M.I.T. with an S.M. in chemical engineering in 1981. During this time he has been working at Albany International Research in Dedham, Mass. on specialty synthetic fibers and textiles. On August 13, 1983, Dirk married Brenda Reale, '83. Brenda is working as a transportation planner in Worcester, Mass. . . . **Steven Berez** graduated from Stanford Business School with an M.B.A. in June 1984. Steve is now working for Action Industries in Pittsburgh, Pa., as director of Consulting Services. . . . Another "local" classmate is **Charles White,** who is on active duty with the U.S. Army, and stationed in Watertown, Mass. at the Army Materials and Mechanics Research Center. While not on active duty, Charles is continuing work on a Ph.D. in mechanical engineering at M.I.T. . . . Captain John Bard is now chief of the Microcomputer Support Branch with the army's 1851st Information Systems Squadron at Offutt Air Force Base, in Nebraska.

Paul Homsy received his M.D. last June from the University of Texas Medical School at Houston. Paul is doing his residency at St. Joseph's Hospital, also in Houston. . . . Another new doctorate is **William Jones**. Bill received a masters degree from Cornell University in 1981, and a Ph.D. from Cornell in electrical engineering in January 1985. Bill is now working at ATT Bell Labs, in Murray Hill, N.J. He is working on SDHT (anyone good at acronyms?) high speed logic devices, which was the topic of his Ph.D. thesis. . . . **Don Monroe** has received his Ph.D. from M.I.T., and is now also working at ATT Bell labs in Murray Hill. Other ex-techies that he has run into there have included Gabe Aeppli, Larry Dubois, and Jim Lavranchuk.

Samuel Nixon has received the award as "Outstanding Young Professional in Washington, D.C." for 1985. He founded and was elected president of the D.C. Coalition of Black Professional Organizations (DCCBPO). He is also serving on the board of directors for the Washington D.C. Association of Urban Bankers (WAUB), and is serving as national networking director of the National Association of Urban Bankers (NAUB). Whew! Sounds like you're keeping pretty busy, Sam! Congratulations on the award! . . . **Kim Zaugg** has been working since October 1984 at Penn State's Beaver Campus (Hey! Are they allowed to use such a prestigious-sounding name?) as assistant to the director of student programs and services. The major part of Kim's job is student activities and programming including orientation. She also helps with admissions and financial aid, and is still working on her D.Ed. in higher education. She has finished all of the course work and "just" has comprehensives and her dissertation left! . . . **Mike Benjamin** is involved with a new venture in the dental instrumentation field. He also got married last September. He and his wife Beth are living on Beacon Hill.

Marion Rideout is at Rice University in Houston, working on her Ph.D. in geochemistry. When she wrote in March, her hopes were that her research would take her to the Wrangell Mountains in Alaska during the summer. Her research concerns the chemistry of volcanic rocks associated with subduction zones and island arcs, like such fun and exotic locales as the Cascades, and Alaska, to name a few! Marion is very interested in hearing from other M.I.T. alumni in the Houston area. If you're out there, please give Marion a holler at 2701 Bellefontaine, Apt. B-3, The Barclay, Houston, Tx 77025, or call her at (713) 664-3591. . . . Marion's fellow Course 12 alum, **Jim Phelps**, is also working on his Ph.D. at Rice. His is in the field of geology of the Brooks Range, Alaska. Jim's work takes him above the Arctic Circle, where he got snowed on last July!

Tony Parham is working for Lotus Development Corp. on an integrated software product for the Apple MacIntosh, called "JAZZ." He worked for a while at a start-up company which folded due to under-capitalization. Tony and his wife Catherine, '83, have moved to Wellesley and have become "instant parents" of six high-school-age girls in their new role as resident directors of Wellesley ABC (A Better Chance). . . . **Kevin Wallace** has moved from Silicon Valley into the city (San Francisco). . . . **Mickey Lee** has switched Hewlett Packard locations, and is now working in San Jose.

As for me, I am busy making some new M.I.T. ties, and breaking some old ones. With elections coming up at our 5th reunion, there will be a new secretary and a new treasurer, so this will be my last *Review* column. With the spare time on my hands, however, I am taking on additional responsibilities with the M.I.T. Educational Council. I will be doing regional coordination work for the area surrounding Cambridge, Mass. (You've all heard of that place?) And then there is M.I.T. commencement coming up, and my annual contribution of "usher." I guess that some people just never leave.—**Ken Turkewitz,** Secretary, 11 Academy St., Arlington, MA 02174

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Abby Schevitz is beginning a residency in internal medicine at Boston City Hospital. She says, "I just can't stay away from Beantown." . . . **Tom Garigan** writes, "I am at Ft. Benning, Ga., attending the Infantry Officer Advanced Course. I'll be attending medical school at the University of Virginia this fall." . . . **Harvey Woehlck,** expecting to get his M.D. June 9, 1985, plans to move to Madison, Wis. for a residency in general surgery. He and Heidi are expecting a baby in October.

That's all this time. Please send news of yourselves or others.—**Chuck Markham,** Secretary, 362 Commonwealth Ave., Apt. 2E, Boston, MA 02115

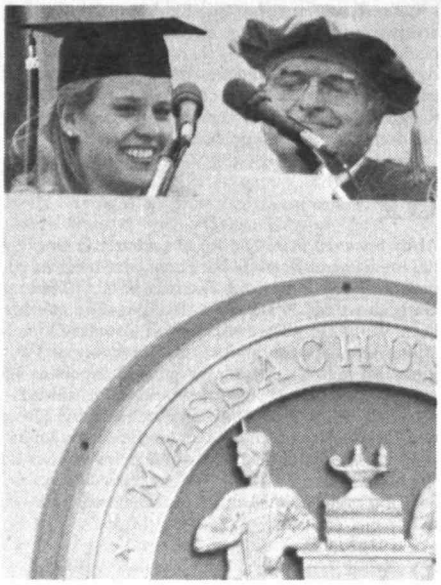
82

Hello Classmates! **Robert Marinos** and his wife, Nancy, are expecting their first child on Labor Day. Nancy's sister-in-law is also expecting her first the week before Nancy. Robert says, "We'll be doubling the fun for Nancy's folks." . . . **Judith Badner** received her M.S. in population genetics from the University of Pittsburgh and is currently a first year medical student there. . . . **John Tenney** has returned from the Peace Corps in Kenya and is now doing biomedical research at NIH in Bethesda, Md. He's planning to go to Stanford in the fall for a master's. . . . **John Gilardi** finished his master's at Stanford last summer and is now working for Flopetrol in Holland/North Sea. . . . **Jim Curme** is a Ph.D. candidate at RPI's Department of Chemical Engineering. He's also resumed playing the trombone and plans to join RPI's brass quintet. . . . **Cathy Worsely Parham** and her husband are house parents for ABC house in Wellesley.

John Burroughs is the proud father of a boy, Michael, born February 8 and weighing 9 pounds, 6 ounces. . . . **Gerard Weatherby** is alive and well and living in Summerville (not to be confused with Somerville), S.C. about half the year. The other half-year he spends in "a big round metal cylinder that goes out into the ocean and sinks itself—more commonly known as a submarine." Gerard got married last September to Julia Ann Goddard, '84. They also have a cat that allows them to feed her and pet her and open the door for her 27 times a day. (I know how that goes, Gerard!)

Peter Merkle writes that he is living in Fullerton, Calif. and working for Dow Chemical marketing advanced composites. He says "Keeping busy mountain climbing (yes, Nancy, mountain climbing) and traveling all over the West." Peter also writes that **Bill** and **Maria Dawson** and **Jeff "Roto" Reuter** are also out there. . . . **Anne Serby** received her J.D. degree last year from Hofstra Law School. . . . **Ralph Ingelese** married Laurie Miller, Simmons '82, a couple of years back. (Who says class notes news is old!) They toured Italy for their honeymoon and loved every minute of it. Ralph's working as an engineer for Intel in Sacremento. He was visited last February by **Bruce Peacock, Mitch Rosenberg, Jeff Sakaguchi,** and **Rich White** for skiing at Lake Tahoe, Nev.

Dave Humphreys was married last year to Sharon Dorn, a native of Seattle, Wash., a chemical engineering grad of the University of Washington, an artist, a scholar, and a beauty! Dave's still in physics grad school at M.I.T., hoping to finish by 1987. . . . **Stephen Bart** expects to re-



"Never have so many worked so hard for so much," said Inge Gedo, '85, president of the graduating class, caught up in the euphoria of the graduation exercises. The thanks of her class to M.I.T. for its people and its place, she told President Paul E. Gray, '54, has three tangible measures—a class gift of $3,826, brought to a total of $9,382 by matching funds from the Class of 1935; the Jimmy Lester Award for contributions to M.I.T. athletics; and a pledge to give an additional $18,500 to the Alumni Fund by 1989, much of which will be for scholarships. (Photo: Frank Revi, '86)

ceive his master's in electrical engineering from M.I.T. any day now. Write soon!—**Rhonda Peck,** Secretary, 38 Bigelow St., Cambridge, MA 02139

83

Hello again, fellow classmates! It is that time again. We have some real exciting news coming up. Also it is a very rare occasion that I can actually write an article without having to contend with air pockets or train vibration. I shall take full advantage of this luxury. And now for the news.

Jeffery Johnson has been named outstanding non-commissioned officer of the year for Pease Air Force Base, N.H. I didn't mean to drop a bomb like that but I didn't know how else to say it. Jeff received this honor as an avionic navigation systems specialist for the 509th Bombardment wing. Congratulations, Jeff! . . . **Robert Labarre** spared no expense in getting our class up to date on his current activities. It seems that Robert is enjoying(?) his second year of med school at University of Penn. As long as you are happy. Say hello to J.T. for us! . . . **Cynthia Bedell** has become quite the world traveller. Cynthia just returned from the Republic of Korea where she worked for her company. Cynthia got a little emotional about how Korea gets SO Aromatic in the spring. Welcome home, Cynthia. Let us know how the seasons in the states compare.

Hey girls, I have some bad news. **Dave Albean** has just announced his engagement to Saheels R. Fett of Idianapolis. Apparently Dave seized the moment in the final lap of the Indy 500 to pop the question. They will be married on August 31. Dave is still at RCA working on a project that might be put on board the space shuttle. Nice going, Dave. . . . **Roy Weinstein** has busted out of University of Texas at Austin. He received that structural engineering degree he has been after. Now Roy likes to spend his free time working for Brown and Root International in Houston. When he is after real excitement he pops over to see Arno Bommer, '82. Roy says he has not been so busy as to forget some other people in his life. He sends a warm congratulations to Mike Colucci, '82, and Theresa Cichello, '84, for their engagement.

Roy Cardoso decided to pack up his bags and leave Chicago Business School. After an entire quarter of negotiations it was mutually decided that the business school would remain in Chicago and that Roy would go back to Boston. Roy is back at the Hanseco Insurance Co. in Boston.

Henry Lin is also in his second year of med school at the University of Illinois. The major difference between Henry and other students is that Henry is enrolled as a James Independent Study Scholar. Henry has decided to devote his life's work to futuristic applications of ultrasound technology in characterizing blood viscosity flow and morphology. . . . **Peter Bianchine** sends his greetings from endocrinology class at Dartmouth's med school. He is very happy in his second year and asked me to tell his brothers at ADP hello. . . . **Allan Matthews,** former Gandhi guru working for Greenpeace, decided, not too long ago, to give it all up and enroll in the JFK School of Government at Harvard. Allan will concentrate in science and technology policy and international affairs. . . . **Steve Kaplan** sends a quick note saying that it is good to be out among the civilized world again. He is finally seeing patients after finishing up his second year at Cornell med school. . . . **Erik Hierbe** graduated from the basic civil engineering corps officer course in Port Hueneme, Calif. I do hope you got a tan, Erik. . . . **Ken Meltsner** has so many things going on he just doesn't know what to do. He is getting married to Janice Eisen, '85; he is working towards his Ph.D. in metalurgy and, for the clincher, he just bought a MacIntosh and a VW Golf. Both are beige! Well Ken, I hope you will be able to tell them all apart.

Now for that moment that everyone has been waiting for. Who will be this issue's Celebrity '83. After spending a great deal of time in this area I have decided to award this prestigious honor to **Peter Kalish.** Peter Kalish is getting married in a few weeks and just happens to be from New York City. It seems that Peter's little brother decided to have a bachelor party for him here in New York and invited me as a representative of the Class of '83. Seeing as I was actually in New York that weekend I decided to go and carry out my responsibilities to the fullest. I felt just like a *Tech* reporter. Here is what I found out:

John Shim is currently at Syracuse med school and has been spending time in local family doctor's offices. John said it was fun since he grew up in the area and knew most of the patients. John said that his two funniest situations were giving an exam to his soccer coach and a COMPLETE physical to an old high school sweetheart. . . . **Martin Kannengieser** accepted a new job with Drexel Burnam and Lambert in new product development here on Wall Street. . . . I was surprised to see **Eric Johnson** showing his face in public. He says his recent publicity has been detrimental to his career at Scott Toilet Tissue. Mainly because his boss was a Tech grad and reads our column. Well, I was very flattered. Eric has begun writing a book entitled *The Five Best Looking Campuses in America.* He would not say which the five were.

Peter Kalish, our celebrity '83 is still working at GE doing something that deals with semi-automatic weapons. Real hush-hush. He will be married in Idaho on June 1 to Kathy whom he met while working in a nuclear reactor. Congratulations Peter and Kathy! I am sorry not many '83ers attended. The activities included a blow-up doll from Peter's fiance, a stripper from his mom, and a video tape of "Debbie Does Dallas II" and I am not sure who gave that.

Things around New York have been fast moving. I am still not in an apartment and enjoy traveling two hours each way to and from work. I will be leaving for Dallas next week for about a month then back home. I was supposed to be leaving for Chicago tonight but I was glad not to go so I could finish this article. I bought a '72 Spider and have been rebuilding that in my spare time. I have also been learning the base guitar and getting in shape for a few track meets this summer. If you know of any parties you would like me to attend, please do not hesitate to write.—**John E. De Rubeis,** Secretary, 47 Gillette Ave., Sayville, NY 11782

85

Hello Class of '85! Congratulations to all of you who graduated in June. And for those of you still at the 'Tute, I'll see you in January when I return to finish my 6A program. Now that everyone has settled into post-graduate life I hope to hear from you all, especially those of you in the San Francisco bay area! Speaking of the bay area, **Jeff Winner, Ray McDowell,** and I have a place in scenic Si-Valley and would love to get together with some of you '85ers. . . . **Adrian Wang** is working for Sentry Test Systems in San Jose with some other recent M.I.T. grads. . . . **Andy Weiss** is also working in the valley as I'm sure many other class members are. . . . **Libby Patterson** is hanging out in Fremont finishing her 6A, and **Shelly Johnson** and **Vince Young** will be coming out to Stanford soon.

So tell me **Gary Wyetzner,** are there any pretty girls at the University of Southern California? If you find any, clue in **Tony Collins** at the University of California, Los Angeles! . . . **Lynne Harth** is finishing up her summer in Los Angeles and will be heading back to New Jersey. . . . However, **Scott Fallek** and **Rodney Schmidt** will both be staying to work down in sunny S.C.

In the midwest **Alex Menchaca** is getting ready for law school in Chicago. . . . **Oliver Patterson** is nearby at the University of Wisconsin grad school. . . . Speaking of grad school, **Bob Unger** is back at the books at Rutgers. . . . **Chiquita White** and **Gene Deune** are also continuing their educations, both in Pennsylvania. . . . **Brad Files** is working for Kodak in Rochester. . . . **Megan Claps** is also in upstate New York at Cornell—far from Texas, where **Bill Maimone** is, along with **Dave Douglas** and **John Wolfe.**

Robin Barker is living in Colorado; she and Tim Chambers, '84, will be getting ready for the big wedding later this year. Last I heard, **Scott Drane** is bumming around somewhere in the states. (Hope to see you in San Francisco sometime, Scott.)

For those of you who are still looking forward to your Europe tour, you should hold off on your visit to England—I expect it isn't the same after the Kappa Sigs dropped by in July. Asia should still be intact though. Check it out with **Alec Atkin** who has been on the road there all summer.

Holding down the fort in the Boston area are **Noelle Merritt, Dan Flores, Lora Silverman, Larry Shapiro,** and **Dow Hardy,** who are all working in the area. . . . **Dave Libby** is finishing up at the 'Tute, as is **Anna Lisa Fear** and **Aaron Wang.**

If you are interested in contacting your local alumni club or organizing Class of '85 activities, drop me a line and I will get you the info or contact the Alumni Association. Also, please let me know your current address so we all can keep in touch. Don't keep me guessing!—**Stephanie Scheidler,** Secretary, 4792 Raspberry Pl., San Jose, CA 95129

Starting on Simplex

The dusty, weed-covered tract northwest of the campus (see shaded area on map at right) that was purchased by M.I.T. a decade ago when the Simplex Wire and Cable Co. vacated its Cambridge factory may yet be made to bloom. M.I.T.'s developer for the 31-acre site, Forest City Rental Properties Corp. of Cleveland, has now completed a plan and is actively seeking approval and financing for a $250-million development involving some 20 new buildings.

The first phase would include renovation of some existing properties plus a new 100,000-square-foot building, both for research and development use, and over 50 units of low- and moderate-income housing. Later will come 150,000 square feet of retail space and a 350-room hotel and conference center.

When will it begin to happen? That depends, says Forest City, on financing and on the environmental impact review process which is now underway. □

MacArthur Grant for Peace Studies

A three-year grant of $750,000 came to M.I.T. late last winter as part of the John D. and Catherine T. MacArthur Foundation's $25 million program to expand U.S. educational programs in arms control and world security.

The MacArthur Foundation's program was announced by President-Emeritus Jerome B. Wiesner, who as a member of the foundation's board of trustees chairs MacArthur's International Security Committee. The program's goal, he said, is to "reduce the 'knowledge gap' between what we understand now and what we need to know to save the planet from extinction.' " It represents, he said, an "unprecedented infusion of new talent and funding," and from it the foundation seeks "a new spirit of . . . investigation that overcomes the limits of disciplinary approaches prevalent in most American academic studies."

M.I.T.'s funds will be used to strengthen existing activities and to "encourage new people into the field who might bring fresh approaches," says outgoing provost Francis E. Low. He cited the Institute's Center for International Studies as "a major interdisplinary center for research and teaching in arms control, defense policy, and international security." □

Grad Housing Crunch

The housing problem for at least half of M.I.T.'s graduate students is so serious, thinks Rene LeClaire, president of the Graduate Student Council, that it is probably forcing some would-be M.I.T. students to opt for institutions with better housing resources.

Five graduate residence halls have accommodations for just over 1,250 single and married students. In addition, some 60 graduate students live in the undergraduate houses, serving as tutors. The rest of M.I.T.'s 4,500 graduate students are at the mercy of the Boston real estate market for rooms and apartments, which in general are scarce, of marginal quality, and expensive.

No near-future relief is in sight. Rents for on-campus graduate housing were raised in 1983 and that increment accumulates in a capital fund earmarked for new graduate housing. The fund is currently committed until 1988 to paying off the conversion last year of the former infirmary to the Green Hall for graduate women. □

DOE Tops List of Research Sponsors

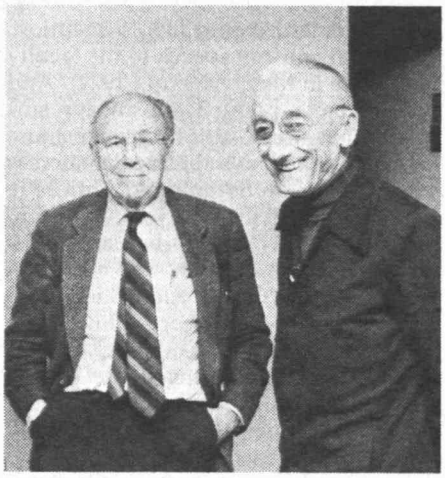
Despite the Reagan administration's emphasis on defense, the Department of Defense (DOD) will rank third among government agencies as sponsors of on-campus research at M.I.T. in 1984-85, according to forecasts by Robert M. Dankese, M.I.T.'s budget director.

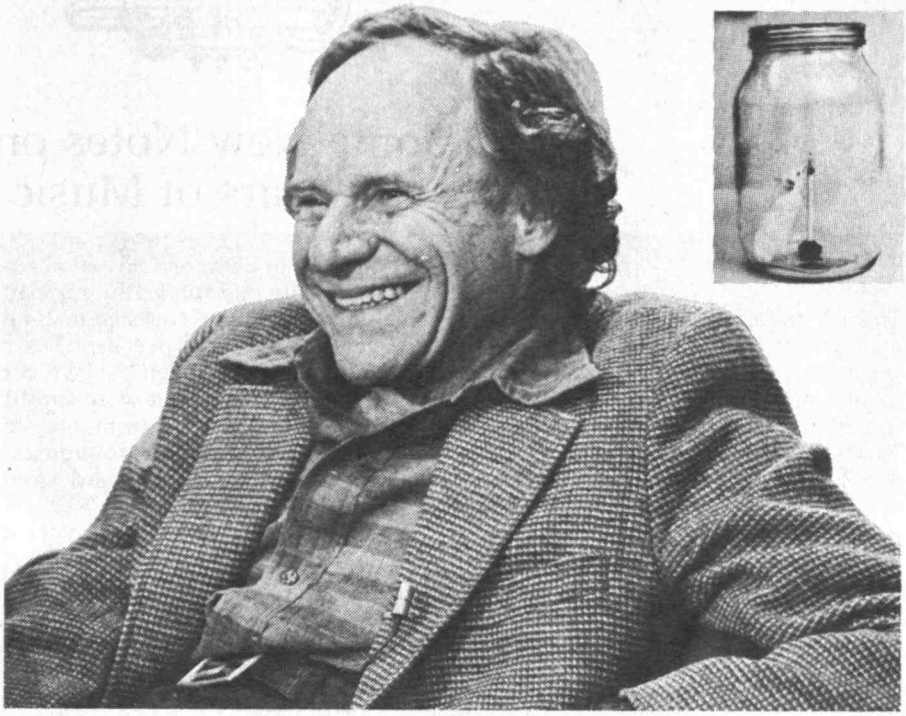
Ahead of Defense will be the Department of Energy, funding about $55 million of sponsored research, mostly on fusion, and the Department of Health and Human Services ($40 million); DOD commitments, not including Lincoln Laboratory, will be about $38.5 million, followed by the National Science Foundation ($32.3 million).

Total sponsored research volume in 1984-85 is estimated at $240 million, not including Lincoln Laboratory; that is 8.3 percent above the actual campus sponsored research volume in 1983-84. Of the

MAP: MIT REAL ESTATE

(Right) Philip Morrison, whose Killian Lectures ranged from ethereal to elementary science. (Below) Doc Edgerton was visited by his sometime collaborator Jacques Cousteau in early spring, to the delight of M.I.T. students. Cousteau showed a film of the first ocean crossing of his experimental vessel powered by a vertical, cylindrical sail.





1984-85 total, industrial funding will cover $32.5 million. As recently as 1978-79, industry sponsored only 5.8 percent of M.I.T.'s research; this year industry's share is 13.5 percent. □

Tuition Up 6.8%

Tuition at M.I.T. will rise to $11,000—up 6.8 percent from last year's $10,300—when school reopens in September. The cost of room and board in the dormitories will also be up—an average 3.2 percent increase of $130 for the year.

Thus the combined costs of tuition, room, and board in 1985-86 will be $15,230, up 5.8 percent from last year's $14,400.

Explaining, President Paul E. Gray, '54, told *The Tech* that universities' costs have risen 2 to 3 percent faster than the consumer price index for the past decade or more, and the trend continues; hence tuition also continues to outpace inflation. But there's good news, too, said Constantine B. Simonides, '57, vice-president: at 6.8 percent, M.I.T.'s tuition increase from 1985-86 is a smaller percentage hike than that of any university in the Ivy League. Harvard's 1985-86 tuition will be $11,360, Princeton's $10,960. "By increasing more," said Simonides, "they're catching up." □

All Levels of Science Grist for His Mill

We live in a universe of whose substance we see only a small part . . . We know that there's 5 or 10 times as much as that in some form which we cannot yet detect . . . It might be ordinary matter but packaged in a strange, unusual way . . . or extraordinary matter, things that have only been suggested in the particle laboratories . . . or it might be the vacuum itself—no neutrinos, no protons, none of those, all flat zero on the average, but the transience can give rise to an energy content.

"All three of these terms will make the same kind of effect . . . I'm not prepared to say I think it's the vacuum, but I think that an open possibility.

"In any case, the story of energy and its measurement by using gravitational forces is a wholly and startlingly new story."

In the course of building to those remarks in the first of his 1985 Killian Faculty Achievement Award Lectures, astrophysicist Philip Morrison swept along with him a standing-room-only audience in room 10-250.

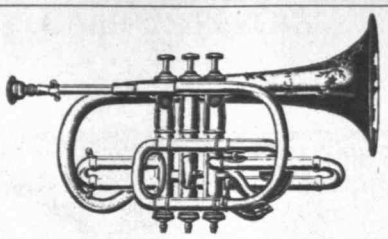
He spoke, using slides to great effect, of the historical concept of energy and the aether—"physical properties given to mere empty space"—and of the astronomical calculations that may reinstate the aether in a contemporary form.

But he retreated from the outer reaches of cosmology at the end of the lecture to share a srongly held conviction: that the functioning of democracy requires a wide public understanding of science and technology, and the schools are the only remedy in sight. Their task, in a time of "easy symbolic access to pictures and results and structures," is to offer "experience with the stuff" of life.

That experience, Morrison illustrated with still more slides, can be delivered with great simplicity of materials and projects for the children, but still requires scientific sophistication from the teachers.

Case in point is the mouse (above), whom Morrison employed some 20 years ago to testify that—thousands of elementary school "experiments" notwithstanding—a lighted candle under a jar does *not* consume all the oxygen in the trapped air before it goes out. Written up in *Science* magazine, this demonstration drew hundreds of letters from offended elementary school teachers and their students. But it shows that there are avenues in which the M.I.T. community can exercise what Morrison sees as its particular responsibility to promote scientific understanding at a fundamental level. □

PHOTOS: FRANK REVI, CALVIN CAMPBELL



Some New Notes on 100 Years of Music

TO THE EDITOR:

This is a friendly footnote to China Altman's "100 Years of Music at M.I.T." (*April, page A4*). One of the musical groups not included in her timeline is the celebrated M.I.T. "Intermission Trio," begun in 1961 by Professor Warren Rohsenow of mechanical engineering and his talented wife, Townely. Mrs. Rohsenow was then looking for some local musicians to play at a faculty dance while the regular hired musicians would be taking their prescribed break. She and Dr. Rohsenow (piano) auditioned Professor Roy Lamson of humanities, who played jazz clarinet Benny Goodman style. They added a drummer, and thus was born a durable and beloved M.I.T. musical tradition—the Intermission Trio.

V. A. Fulmer, S.M.'53
Secretary of the Institute

China Altman's excellent article on music at M.I.T. gave only a passing mention to jazz—perhaps for lack of available information. I was very involved with jazz on the M.I.T. campus in '55-'57 before leaving to finish school elsewhere, and I thought your readers would like to know a little of what went on in those days.

I had been an apostle of jazz in high school. But when I got to Tech and Boston, I had to dig around just to buy records. There was quite a bit of jazz being played in Boston clubs, including Pomeroy's fine band. The real action was at a place called the Stable, a spot on Copley Square where the locals jammed. The name groups were largely booked into George Wein's Storyville, about which more anon. The only jazz on any campus was a very low-profile group of Harvard fans.

I twisted some arms over the WMIT (they were still on low-power wire, this was before WTBS) and finally got a jazz show, but I had to play many hours of classical music as penance. . . . The M.I.T. Jazz Society had been launched sometime prior to my arrival, and our first big break was Kresge Auditorium. It had just been built, and it was, in addition to being acoustically superb, largely empty! Well, we wasted no time . . . Can we have this weekend? . . . Tuesday night? . . . Great! . . . We got some groups on stage. The word spread quickly, and our turnouts went into the hundreds, mostly from other campuses, Brandeis in particular. Harvard even sent a group down.

When musicians were in town for a session, we asked them to give a concert for the MITJS. When Stan Getz brought his quintet (Brookmeyer, Sunkel, Williams, I forget the bass) to town at Storyville. Our real friend down there was George Wein's ADC, a very patient guy named Charlie Bourgeois; if we got anything it was due to Charlie. We of course asked for Getz and were quickly turned down; he was a very big name at that time. Well, the story goes, and I really think this is the way it happened, that Stan was riding up Mass. Ave. the next day, asked about the "acoustically perfect" Kresge Auditorium, and told Charlie that he'd like to play there sometime. One phone call from Charlie to me and we were off and running. With about four days notice, were on the phone to everyone; we had volunteers sitting up nights doing posters on the back of salvaged MITJS posters from earlier concerts. The concert was standing room only, and the M.I.T. Jazz Society was well entrenched. The Baton Society gave us some recognition and gave me an award for having accomplished the most for music on the M.I.T. campus in '55-'56.

Paul Padget
Cincinnati, Ohio

What a marvelous job China Altman did with her piece on music at M.I.T. I don't know how she could put that much together and with such understanding. For one who has been in it for thirty—if not for 100 years—her article is a miraculous masterpiece. She has done a great service to music at the Institute by stressing what I consider the most significant aspect: "a native musical culture built from the inside out."

Two points I would like to mention. One small one: my speech to the faculty took place in May, 1970 (not 1972). And then a major point: I am always surprised that M.I.T. does not take more note of John Oliver's spectacular success with the Boston Symphony. I am sure China knows all this and wanted to concentrate on M.I.T. only—but still, allow me to say "even so—."

Klaus Liepmann
Westport Point, Mass.

China Altman's account of the history of music at M.I.T. oversimplifies one moment of controversy. It is certainly true that Professor Klaus Liepmann, drawing on his experiences in Germany in the 1930s, spoke eloquently and with great effect to the faculty at a crucial meeting during our debates on defense research and governance. It is not accurate to say that the ovation following Professor Liepmann's remarks was unanimous, or to imply that his remarks were the only decisive moment of the long debate.

This is a note to set the record straight and not to detract from China Altman's fine piece.

Constantine B. Simonides, '57
Vice-President, M.I.T.

Your story about 100 years of music at M.I.T. was read with interest. However I did feel short-changed not to find any mention at all the old "Tech Show." There should be much about it in *Technique* for many of the years before 1931, when the show petered out. Jim Donovan, '28, is a well-known alumnus whom I recall as being one of the leaders. I can say that it was a full-scale musical production, with costumes, scenery, orchestra, chorus, and dancing "girls." Much of the material was written by students. The Tech Show played several days in a Boston theatre and traveled to a few outlying ones: Northampton, Mt. Holyoke, Melrose, and perhaps New York, among others.

Charles B. Pear, Jr., '39
Melbourne, Fla.

I CIVIL ENGINEERING

Promotions to the rank of full professor have been announced for two members of the department faculty at M.I.T.: **Gregory B. Baecher,** Ph.D.'71, and **Oral Buyukozturk**. Baecher is currently working on applications of robotics in construction, having earlier made important contributions to the analysis of uncertainty in geotechnical engineering. A graduate of Cornell, Buyukozturk is associated with the department's Constructed Facilities Division, where his work focusses on the mechanical behavior of materials in engineering applications.

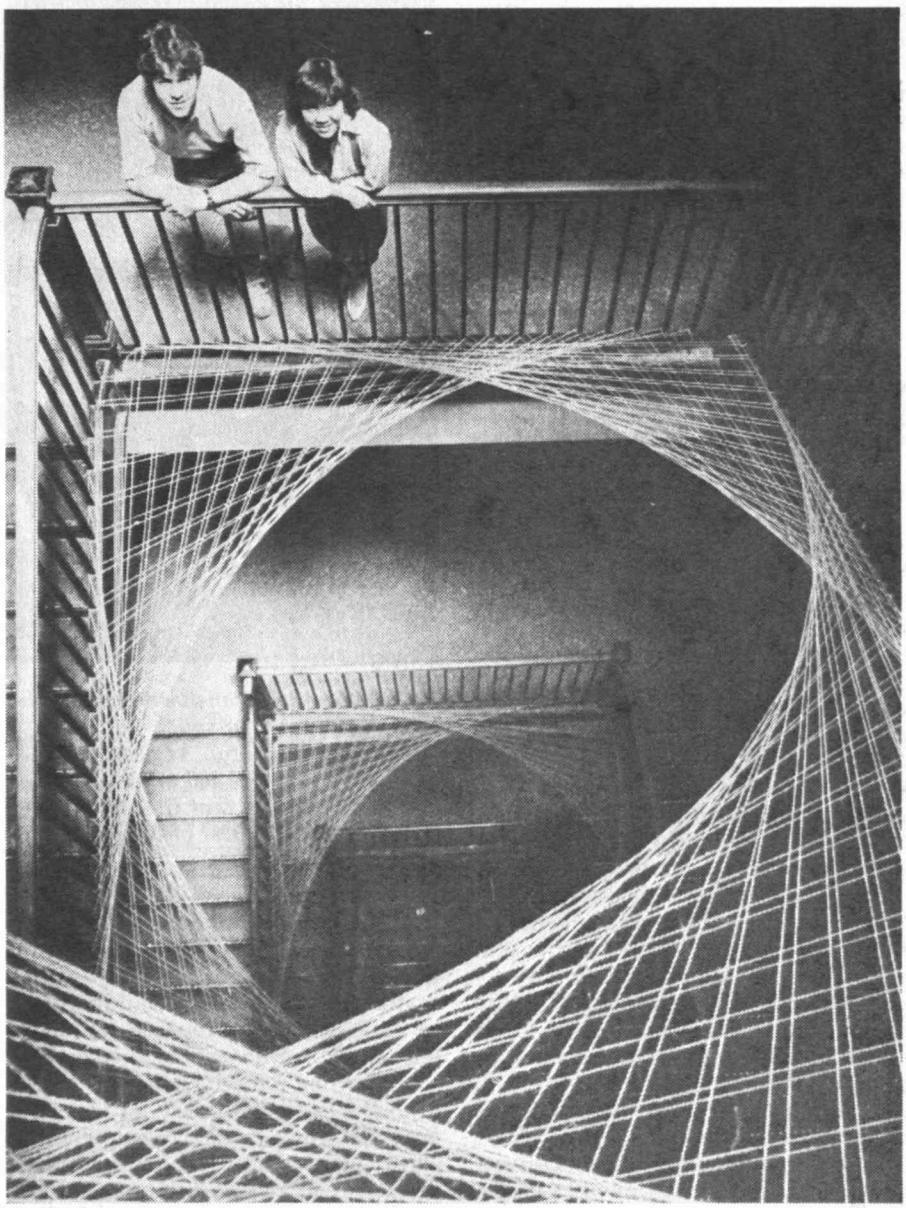
Robert F. Seedlock, S.M.'40, was honored this spring with the Gold Medal Award for 1985 of the Case Institute of Technology Alumni Association. It honors "distinguished achievement" by alumni of the institution, which has now combined with Western Reserve University to form Case Western Reserve. Seedlock, who retired from the Army with the rank of major general, is now associated with the Washington office of the Ralph M. Parsons Co.

Writing to inform us of his award (*see above*), Seedlock also reports the death early this spring of General **Jackson Graham,** '40, who was retired from military service and living in Palm Springs, Calif., at the time of his death.

Graham was the first general manager of Washington's Metro transit system who took that subway system from paper to a reality, passed away on March 2, 1985, in Palm Springs, Calif. Graham came to Metro in 1967 after spending 31 years in the Army Corps of Engineers (rising to the rank of major general). During his nine years with Metro (until his retirement in 1976) Graham brought 45 miles of subway under construction and directed the completion of five stations. "To me, the outstanding thing about Jack, in addition to being the master builder, was the incredible integrity he built into the massive project," said Theodore Lutz (Graham's successor) to a reporter from the *Washington Post*. The *Post* editorialized, "While permanent, living tributes to other public figures may take time to design and erect, Washington's tribute to Jackson Graham—and vice versa—is already on track."

Katherine Oven-Thompson, S.M.'81, has been promoted to project engineer in the Environmental Quality Division of Metcalf and Eddy, Boston. . . . **Peter K. Kitanidis,** Ph.D.'78, is associate professor in the Department of Civil and Mineral Engineering at the University of Minnesota. . . . **Gino J. Baroni,** S.M.'80, is currently working for Beacon Construction Co. as vice project director of the Rowes Wharf, Boston, project. . . . **Chi-Kuo Mao,** Ph.D.'83, writes, "I have been the head of the Management Science Department at National Chiao Tung University in Hsin Chu, Taiwan, since August 1, 1984."

Robert Bahij Saba, '61, reports, that since January 1, he has been engaged in development/building activities for single-family dwellings, townhouses, shopping plazas, professional office buildings, etc., in Allison Park, Penn. . . . **Fujio Matsuda,** Sc.D.'52, president emeritus of the Uni-



A hack? A work of art? Yes to both. This elegant string design, photographed for the June 15 issse of Tech Talk, *graced the stairway of Building 4 in June. It was the creation of freshmen Chris Thorman and Fang-Pin Lee (above). The plan was conceived in one hour and took eight hours to construct. The $40 cost of the twine was reimbursed by Cecil and Ida Green Career Development Professor Frank Morgan, who identified the structure as a parabola. (Photo: Calvin Campbell)*

Civil Engineering: After 120 Years "the Best of Times"

Civil engineers today are just where they've always been—at the very center of society's interface with technology, building the systems and structures in which we live and work.

But civil engineering is not exactly riding the crest of a wave. Productivity has been falling and costs rising faster than inflation. Indeed, says Gerald L. Wilson, '61, dean of M.I.T.'s School of Engineering, the whole civil engineering profession earned a reputation for resistance to change during the post-World-War II era by failing to capitalize on new technology that could make its work faster, cheaper, and better.

After that sobering analysis, it was all upbeat for the 400 alumni who returned in April to mark the Department of Civil Engineering's 120th birthday. They attended a symposium described as "a celebration of the future and all its promise" by Professor Joseph M. Sussman, Ph.D.'68, head of the department.

No wonder the expansive mood of Professor Joseph M. Sussman, Ph.D. '66 (standing, top photo). As head of the department, he and 400 other alumni had just been told that its 120th anniversary was "the best of times" for M.I.T. civil engineers.

Revolution in Construction

The construction industry at once fulfills Wilson's pessimism and Sussman's optimism. Preoccupied with labor problems, embattled by environmental, regulatory, and liability litigation, and suffering the effects of recession, the industry lost ground in the 1970s—a sleeping giant, says Professor Fred Moavenzadeh, who heads the department's Center for Construction Research and Education. But now new materials and methods promise a revolutionary increase in productivity—a change comparable with that achieved when machine power was substituted for that of men and animals in the construction industry in the 1920s. "We totally disagree that construction is a dead issue," said Moavenzadeh, citing a host of new developments in cement, ceramics, polymerics, and composites and new machinery for using these materials quickly and efficiently.

There's also a new relationship between labor and management in the industry, said Moavenzadeh—a realization by both of the necessity to work together. All this points to doubling or tripling the industry's labor productivity by the year 2000, he said.

Computers and robotics will be major sources of these gains, and civil engineers are now growing "computer-wise" in record numbers, said Professor Robert D. Logcher, '58. Already computers are well entrenched in design, drafting, and scheduling. But more will be done with the advent of artificial intelligence. By the end of this decade, said Logcher, a machine should be able to explore—for example—all the ramifications of any single design change on all the other parts of a building and on its total cost. Design will be integrated with construction, and most drafting rooms will have disappeared.

Furthermore, as mainframes give way to personal computers, the machines are moving onto the work site itself. These computers can help foremen by setting schedules and allocating materials and workers. The same computers will help the eventual owners and operators of the new structures by providing complete documentation of how the structure was assembled and what it contains—how structures were conceived, even what pipes go where.

Coming next: robots—machines to automatically perform construction operations that now must be done manually. That's a tough problem, because construction sites are uncontrolled environments compared with the factories where today's robots are at work. Among the first tasks to be automated, said Professor Gregory B. Baecher, Ph.D.'72, head of the Constructed Facilities Division: crane operation, materials handling, stone cutting, surface finishing, inspection, concrete pumping and distribution.

One result already, as an example: modern computer-controlled methods of cutting and erecting stone make it cost-competitive with other exterior treatments, whereas it used to be possible only for institutional buildings and monuments, said Dennis Fitzpatrick, S.M.'81, president of David O'Connell Sons, Inc., Holyoke, Mass.

M.I.T. and Carnegie Mellon University are mounting a joint robotics-in-construction research and development program, said Baecher. C.M.U. is studying automated structural assembly while M.I.T. studies a robot to move soil or other materials at a construction site. In five years, he pledged, robotics for construction will be "a major part of our program" in Cambridge.

A Sense of Family

Whether because of adversity or optimism, M.I.T. civil engineering alumni are a close-knit clan, and a sense of family pervaded the April reunion. Sussman wants it that way: he hopes for increasing alumni-department interactions, a free flow of new ideas from the field and back into the profession. Charles L. Miller, '51, who was head of the department for nine years in the 1960s, liked the sound of that. If it works, he said, the next ten years can be "the most exciting time in the history of civil engineering—more challenges, more potential for doing more important things than ever before.

"This has to be the best of times," Miller said.—*John Mattill* □

versity of Hawaii, is currently executive director of the UH Research Corp.; he has been elected a director of the First Hawaiian Bank, Honolulu. . . . **Steven G. Vick,** S.M.'73, a consulting geotechnical engineer in Indian Hills, Colo., is the author of *Planning, Design, and Analysis of Tailings Dams*, published by John Wiley and Sons. The book is intended to help geotechnical engineers extend basic earth dam design and soil behavior principles to mine tailings dams and to familiarize them with issues in mine waste disposal and other technical disciplines.

Peter Homack, S.M.'41, a principal of Elson T. Killam Associates, Inc., Millburn, N.J., passed away in December 1984. Homack's career spanned 40 years in the field of environmental engineering, beginning in 1942 with the United States Navy as assistant design superindendent. Homack joined Killam Associates in 1945 as an assistant engineer, rising to president in 1964 and chairman of the board in 1977. He was author of several technical papers, held positions with many professional societies, and was involved in social and community affairs. . . . **James R. Higgins,** S.M.'34, of Kansas City, Mo., passed away on October 18, 1984; no further details are available.

II MECHANICAL ENGINEERING

Can electricity, coal, and steam substitute for oil and diesel to generate electricity and drive railroad locomotives? **Frederick A. Prahl, III,** '63, says the answer is yes. Indeed, he has formed the National Steam Propulsion Co. to exploit the plan to re-engineer diesel-electric locomotives to burn coal at a cost that would be repaid by fuel savings in two years. The secret of the plan is a fluidized-bed boiler of high efficiency, a proprietary design of Prahl's company. The existing diesel engine could readily be modified to operate with steam, Prahl says, producing a coal-fired steam-electric power plant at minimal conversion cost.

Charles R. Cornell, S.M.'69, reports, "Since April 1984, I have been vice president of Dohner and Associates, Inc., Woodbridge, Ill. The firm specializes in the design, development, and production of microprocessor-based engine and hydraulic control systems for off-highway and heavy-duty equipment." . . . **Steven Moore,** S.M.'83, is an engineer at the Xerox Corp., Rochester, N.Y. . . . **Frederic C. Young,** S.M.'60, resigned last April 30 as vice-president, treasurer and director of Analogic Corp., Wakefield, Mass. . . . **Don F. Pardo,** S.M.'80, writes, "I have recently formed Digital Sciences Corp., San Diego, specializing in commercial and governmental applications of DEC computer systems."

Joseph C. Batty, Sc.D.'69, reports his recent activities: professor of mechanical engineering and nutrition and food sciences at Utah State University; associate director of the Utah Water Research Laboratory; principal author of *Fundamentals of Food Engineering*, (a textbook) published by John Wiley and Sons (1984); author of *Salt-Gradient Solar Pond Research at the Great Salt Lake* and a consultant to the United Nations Development Program. . . . Professor **Serope Kalpakjian,** S.M.'53, of Illinois Institute of Technology has recently published two books: *Manufacturing Processes for Engineering Materials* (Addison-Wesley); and *Lubricants and Lubrication in Metalworking Operations* (Marcel Dekker).

William Thomas Brydges III, Sc.D.'67, has been named director of planning of the Electronics and Telecommunications Group of Corning Glass Works, Corning, N.Y. Brydges joined Corning in 1968; his most recent position was director of corporate planning, Marketing and Business Development Division. . . . **Daniel O. Jones,** S.M.'82, is involved in Stirling engine design and analysis with Mechanical Technology, Inc., Lotham, N.Y. . . . **Harry Majors,** '44, was made a life fellow of the ASME in 1984 and was named Engineering Educator of the Year 1985 by the Puget Sound Engineering Council.

III MATERIALS SCIENCE AND ENGINEERING

R. Eric Spjut, Ph.D.'85, has joined the M.I.T. faculty as the first John Chipman Assistant Professor of Chemical Process Metallurgy. Spjut's research for the doctorate in chemical engineering awarded at M.I.T. early this year was on an electrodynamic-thermogravimetric analyzer for studying heterogeneous reactions of single particles at high temperatures. The announcement of his appointment, made late last spring, marked the successful completion of a fund to honor the late John Chipman, long-time department head. At the same time the first John Chipman Distinguished Lecture was given by Frank W. Luerssen, chairman and chief executive officer of Inland Steel Co.

David Dennis Marchant, Sc.D.'74, is currently a research associate at Standard Oil Co. (Ohio), Cleveland. Prior to joining Standard, Marchant was a senior research scientist at Battelle Pacific Northwest Laboratories. . . . **George Krauss, Jr.,** Sc.D.'61, has been appointed director of the Steel Research Center, Colorado School of Mines. The center is a university-industry cooperative research center supported by the National Science Foundation and industrial sponsors. . . . **Charles O. Smith,** Sc.D.'47, professor of mechanical engineering at Rose-Hulman Institute of Technology, Terre Haute, Ind., has been named to a six-year term as a member of the Accreditation Board for Engineering and Technology—a national engineering board designed to evaluate the engineering programs at colleges and universities.

Axel Erik Nygren, S.M.'51, of Fagersta, Sweden, passed away after a long illness on January 8, 1985; no further details are available.

V CHEMISTRY

K. Barry Sharpless, professor of chemistry at M.I.T., and **Richard Bersohn,** '44, professor of chemistry at Columbia University, were honored late last spring by election to the National Academy of Sciences. And Professor **Christopher T. Walsh,** head of the department at M.I.T., was chosen for membership in the American Academy of Arts and Sciences.

John M. Deutch, Ph.D.'66, provost of M.I.T., has been elected to the Board of Directors of the Perkin-Elmer Corp., Norwalk, Conn. . . . **John A. Schneider,** Ph.D.'66, senior project manager for oxazolines in the Commercial Opportunity Development Group of Dow Chemical U.S.A., Midland, Mich., has been named project director. Schneider continues his responsibilities for oxazolines as well as for the development of the commercial and technical strategy for the Dow catalyst business.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

A new two-year fellowship given to Massachusetts General Hospital by Analog Devices, Inc., will be held during its first year by **Paul Grimshaw,** '80, who is now a graduate student at M.I.T. Grimshaw will study the possible use of electric-field technology for administering drugs to patients.

Two members of the department at M.I.T. were honored late last spring by election of the National Academy of Sciences: **Mildred S. Dresselhaus,** Abbey Rockefeller Mauze Professor of Electrical Engineering and Physics, and **Erich P. Ippen,** '62, professor of electrical engineering.

Marvin L. Minksy, Donner Professor of Science in the department at M.I.T., is the editor of a new book on *Robotics* that is called by its publisher, "the first authoritative report from the ultimate high-tech frontier." In his introduction, Minksy himself is wholly optimistic about "machines that display genuine signs of having minds. We'll start to give them learning skills to organize their little minds, so that they can learn from us and from each other as we do. We'll show them how to make copies of themselves. . . . We'll give them limbs even more dexterous than our own and new kinds of senses that will seem to us uncannily observant. . . . But what will happen," Minsky asks, "when . . . intelligent machines begin to do the things that we ourselves *like* to do? . . . This book," he writes, "is for those who have the courage and disposition to answer such questions." Among the authors: **Philip E. Agre,** S.M.'83, who is now a graduate student in Minsky's Artificial Intelligence Laboratory.

Two members of the faculty at M.I.T. have been advanced to the rank of full professor: **Jeffrey H. Shapiro,** '67, and **Donald E. Troxel,** Ph.D.'62. Shapiro, whose advanced degrees are also from M.I.T., is a specialist in system optics, the application of signal analysis and communication theory to optical propagation, communication, and imaging. Troxel, a member of the faculty since 1962, has recently specialized in high-performance image-processing systems for the graphic arts industry.

Professor **John G. Kassakian,** '65, of the M.I.T. faculty has joined the Board of Directors of Sheldahl, Inc., Northfield, Minn., maker of electronic products.

Stephen T. Kent, Ph.D.'81, was appointed chief scientist of BBN Communications Corp., Cambridge, in January 1984. . . . **Paolo Lepri,** S.M.'62, is managing director at "Fabrica Informatica" Selenia S.P.A., Rome, Italy. . . . **Robert L. Baughan, Jr.,** S.M.'49, of Chambersburg, Penn., lists his recent career highlights: 1975—retired from the U.S. Navy as rear admiral; 1979-81—attended Lutheran Theological Seminary at Gettysburg, Penn.; June 1981—ordained as pastor in the Lutheran Church in America; and September 1984—retired from full-time parish ministry. . . . **Leonard M. Magid,** Ph.D.'62, has been promoted to a principal at PA Technology, Hightstown, N.J., an international business management and technology consulting firm. Magid was formerly senior vice president of Meridian Corp., a Washington, D.C.-based consulting firm. In 1974 he was responsible for creating the U.S. National Photovoltaic Solar Energy Conversion Program.

Michael G. Loui, Ph.D.'80, writes, "I have won the 1984 Everitt Award for Teaching Excellence in the College of Engineering at the University of Illinois, Urbana-Champaign. Also, I won the 1985 Dow Outstanding Young Faculty Award of the American Society for Engineering Education." . . . **Edward E. David, Jr.,** Sc.D.'50, president of Exxon Research and Engineering Co., Annandale, N.J., gave the keynote address—"Computer Simulation and the Demand Reality"—at the 1985 Summer Computer Simulation Conference held in San Diego in July.

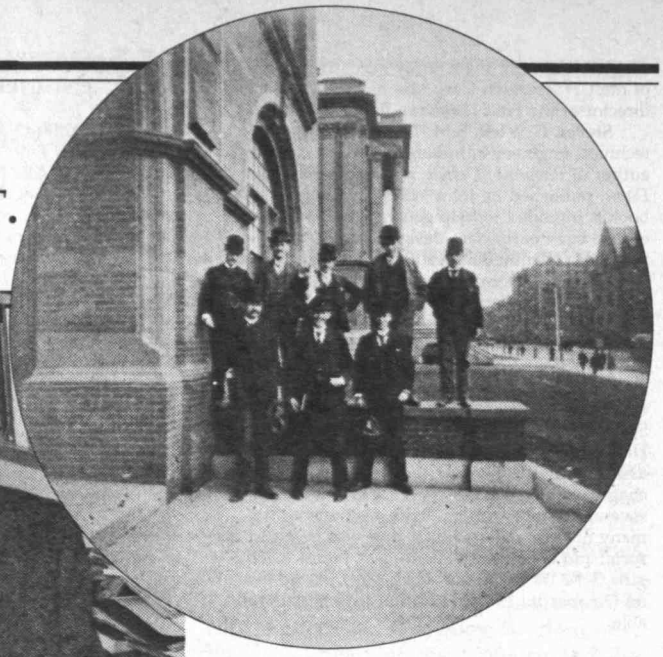
VI-A INTERNSHIP PROGRAM

The definitive work, *A Century of Electrical Engineering and Computer Science at M.I.T., 1882-1982*, published by the M.I.T. Press, has finally reached the bookstores. Two people associated with VI-A are the co-authors: Professor Emeritus **Karl L. Wildes,** '22 and **Nilo A. Lindgren,** '48. Professor Wildes was Professor William H. Timbie's assistant in the running of Course VI-A for many years, and Nilo Lindgren is a VI-A graduate.

A celebration for the authors was held on May 18, 1985, at Carleton-Willard Village, a retirement home in Bedford, Mass., where Professor Wildes now lives. Those attending included co-author Lindgren, Institute Professor Emeritus **Gordon S. Brown,** '31, Institute Professor Emeritus **Harold E. Edgerton,** '27, EECS Department Head Professor **Joel Moses,** '67, Associate Department Heads Professors **Richard B. Adler,** '43 and **Fernando J. Corbato,** '56; Mrs. Harold L. Hazen, under whose husband, as department head, Professor Wildes served; VI-A Director John A. Tucker, and the wives and children of several faculty members.

At a brief presentation ceremony, Frank P. Sat-

How the Electricals Rose to Conquer M.I.T.



"A bunch of electricals," photographed about 1890 on the steps of M.I.T.'s Back Bay buildings, proves the emergence of this new discipline. How it rose to be the largest at the Institute has now been told by authors Nilo Lindgren, '48, and Professor Emeritus Karl Wildes, '22. (Photos: M.I.T. Museum and John A. Tucker)

Electrons are ubiquitous, and in its quest for ways to make them work for humanity electrical engineering has arguably become the most diverse and—despite a tardy start—the largest of the engineering professions.

Those same qualities—late start, rapid growth, and great diversity—characterize what is now M.I.T.'s largest department.

Electrical engineers have been fundamental in building M.I.T., numbering among their ranks an impressive share of the Institute's great names: Bush, Timbie, Brown, Jackson, Gray, Bowles, Hazen, Terman, Guillemin, Gray, Edgerton . . . even Alexander Graham Bell, who found in M.I.T. a receptive audience and congenial community for his ideas about the telephone.

Chronicling this history has been the 20-year passion of Professor Emeritus Karl Wildes, '22, joined more recently by Nilo Lindgren, '48, of the Electric Power Research Institute. Now the fruit of their patient and prodigious labors has been published by the M.I.T. Press—*A Century of Electrical Engineering and Computer Science at M.I.T., 1882-1982* ($15.00).

Every Effort a "Best Effort"

It all began in the M.I.T. Physics Department, where Professor Edward C. Pickering was giving pioneering lectures in electrical science as early as 1866. Professor Charles R. Cross, '70, one of Pickering's students, continued the tradition after Pickering went on to Harvard, and by 1882—when Cross was head of the department—there was a formal spring series of optional lectures on the practical applications of electricity.

From there it was a short but momentous step for Cross to establish within the Physics Department what is generally recognized as the first electrical engineering curriculum in the U.S. Its first graduates received degrees in 1885, and 17 years later electrical engineering became a full-fledged department.

A few highlights from 80 years thereafter, as chronicled in detail by Wildes and Lindgren:

☐ How the switch from direct to alternating current changed the character of electrical engineering by pushing its protagonists back into physics and mathematics.

☐ How communications gradually upstaged power in the department's teaching and research.

☐ How the electricals were the first users of the Institute's new Cambridge property in 1913 and commandeered a central spot for their largest laboratory in the buildings completed there in 1916.

☐ How research on illumination brought the electricals into the realm of psychology.

☐ How the first patents of Professor Harold E. Edgerton, Sc.D.'31, and his student Kenneth Germeshausen, '31, were written by an attorney who was to receive "what we thought the effort had been worth" if there were any royalties.

In his introduction to the book, President Paul E. Gray, '54, attributes the department's success to its embrace of four cardinal principles:

☐ Steadfast attention to teaching. "Few other departments have known so many uncommonly gifted teachers," said President Gray.

☐ Determination to engage current problems and anticipate future ones.

☐ "A complete acceptance of the doctrine that teaching and research play mutually reinforcing roles."

☐ Overriding concern for quality. "The influence and strength of the department," writes President Gray, "result in large measure from its insistence that every enterprise, every new development, be a best effort."

But even without President Gray's insight as a former student and teacher in Course VI, readers of this chronicle will understand why success has been the department's biggest problem—its magnetism for students leaving other M.I.T. departments depopulated and electrical engineering pressed for resources.—*John Mattill* ☐

low, executive editor of the M.I.T. Press, presented Professor Wildes with an enlarged framed copy of the book's jacket cover. There followed the cutting of a large cake bearing the inscription: "Congratulations Professor Wildes," followed by a buffet social hour.

The following day, at the department's annual spring party at M.I.T.'s Endicott House in Dedham, Mass., the book's publication was announced by Professor Adler. Nilo A. Lindgren was also recognized with the presentation of a framed enlarged copy of the book jacket.

The book was more than 12 years in preparation and is a comprehensive work covering the activities and growth of this prestigious department. VI-A'ers will be especially interested in Chapter 7—"The Industrial Cooperative Program: William H. Timbie and Course VI-A"—which is complete up through the present director. Copies are available locally at the Tech Coop and the M.I.T. Press store.

This being awards time of year, we are extremely pleased to announce a number of recipients from the VI-A fellowship. First, let me acknowledge one who is not a VI-A graduate but whom many VI-A's will recognize as having done a lot for program members: Ms. Marilyn A. Pierce, administrator in the EECS Department Graduate Office, was presented one of the three James N. Murphy Awards "given to employees for spirited contributions that have won a place in the hearts of students." She is certainly deserving of this if only for what she has done to help graduate students in the VI-A Program!

Two VI-A students received Karl Taylor Compton Awards recognizing "outstanding contributions in promoting high standards of achievement and good citizenship": graduate student **Carey M. Rappaport,** '80, for his work as a graduate tutor in East Campus; and senior **Stephanie L. Scheidler,** 85, "for leadership in student government and membership on the Corporation Joint Advisory Committee and the faculty Committee on International Institutional Commitments."

Ondria G. Jaffe, '85, who earlier received a prestigious NSF fellowship, was given the Association of M.I.T. Alumnae Award for "excellence in course work and related professional activities." . . . **William T. Maimone,** '85, was presented the Frederick G. Fassett, Jr., Award for "his dedication and service in furthering the ideals of fraternity at M.I.T." . . . Graduate student **Davis Y. Pan,** '80, was awarded one of the William L. Stewart, Jr., Awards for "special contributions as head of the Graduate Student Council's Activity Committee, initiating a number of social activities."

Graduate student **Robert W. Baldwin,** '79, was promoted to instructor for his outstanding teaching performance in the EECS Department. . . . **Michael C. Fu,** '84, is a recipient of an NSF fellowship. . . . **Patrice M. Parris,** '85, the "male senior athlete of the year," won the Class of 1948 Award and one of two Malcolm G. Kispert Awards for his "contributions to the track team."

Congratulations also go to faculty member **Donald E. Troxel,** '60, who has been promoted to full professor. Don serves as our VI-A faculty advisor to Honeywell/Billerica and IBM/Kingston.

Visitors to the VI-A Office since last writing have included: **Thomas H. Crystal,** '59, with the Institute for Defense Analysis (IDA) whose son, Michael R., '86, is currently enrolled in VI-A with Fairchild/Schlumberger; **Holton E. Harris,** '44, president of his own company, whose son, Walter D., '86, is in Course VI; **Karl M. J. Lofgren,** '75, who is with Western Digital in Irvine, Calif., and who works with **George P. White,** '71, who had some VI-A students working for him on the Nu Machine during the summers of '83 and '84; and **Andrew E. Moysenko,** '72, who is with Sanders Associates, Nashua, N.H.

During the semi-annual VLSI review held at M.I.T. in May, we ran across **Ronald R. Troutman,** '62, who's not far from us in Essex Junction, Vt., with IBM Corp., where we also have VI-A students. . . . Graduation and Technology Day each year bring back families and VI-A friends as visitors on whom we'll report in an upcoming issue.—John A. Tucker, Director, VI-A Internship Program, M.I.T., Room 38-473, Cambridge, MA 02139

X CHEMICAL ENGINEERING

William M. Deen, who joined the M.I.T. faculty in 1976, has been promoted to the rank of full professor. A graduate of Columbia and Stanford, Deen works in the fields of biomedical engineering and transport phenomena. His early work with the National Kidney Foundation is widely known, and he has also significantly advanced scientific understanding of the permselectivity of membranes.

The department at M.I.T. has inagurated a new lectureship in honor of Professor **Hoyt C. Hottel,** S.M.'24, who has been a faculty member since 1924. Hottel made major contributions to the understanding of radioactive heat transfer, combustion, and solar energy. The lectureship is aimed at increasing the interaction of students and faculty with engineers and scientists outside the local group. The initial lecture, given by Hottel—"The Fiery Furnace"—was presented last April.

Charles P. Marion, Sc.D.'52, reports that he has contributed an article on the Texaco gasification process to the Japan Petroleum Institute process handbook. . . . **Stanley Herzog,** Sc.D.'64, has been appointed director of technology and process at Heyward-Robinson International, New York City, a full-service engineering firm. . . . **Howard S. Dilts,** S.M.'41, president of J. Davies Associates, San Jose, Calif., has been invited by the Citizen Ambassador Program of People to People International to join an American delegation to visit the People's Republic of China. The delegation's purpose is to share and gain insight into the issues of spacecraft design, manufacturing, and testing.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

A new honor late this spring for **B. Clark Burchfiel,** Schlumberger Professor of Geology at M.I.T.: membership in the National Academy of Sciences. . . . And a different, but similar, honor to **Robert M. White,** Sc.D.'50, president of the National Academy of Engineering: membership in the American Academy of Arts and Sciences.

The rank of full professor at M.I.T. was awarded to **James L. Elliot,** '65, who is best known in the field of astronomy for his discovery in 1977 of the rings of Uranus. After completing advanced degrees at M.I.T., Elliot held research posts at the Smithsonian Astrophysical Observatory and Cornell before returning to M.I.T. in 1978, where he has continued pioneering planetary studies.

C. Scott Cameron, Ph.D.'81, research geologist with Shell Development Co., Houston, has recently received a Shell Achievement Award, in recognition of his outstanding work studying regional geology of the Arctic. . . . **Faith Vilas,** S.M.'75, reports, "Completed my Ph.D. in planetary sciences at the University of Arizona in October 1984. Now have a National Research Council post-doc at the Johnson Space Center. Part of my thesis included the optical design and testing of the coronagraph used to image the solar system around Beta Pictoris and Uranus' rings. I am also part of the discovery team for the ring arc of Neptune."

Steven J. Ostro, Ph.D.'78, is staff scientist at the Radar Sciences Group of the Geology and Planetary Section at the Jet Propulsion Laboratory Pasadena, Calif. . . . **Louis C. Raymond,** S.M.'32, is the author of a three-part book, *Spindle Whorls in Archaeology,* published in 1984 by the Department of Anthropology at the University of Northern Colorado.

David M. Garrison, S.M.'72, retired from the Air Force in 1984 with the rank of major and is now a project manager for Third Party Software, Inc., Council Bluffs, Iowa. . . . **Till E. Stoeckenius,** S.M.'80, is currently a senior meteorologist at Systems Applications, Inc., San Rafael, Calif., working on "projects involving the presentation of technical information to non-technical decision-makers in the environmental field. Emphasis is on the use of probabilistic techniques to indicate uncertainty due to the lack of hard scientific evidence in support of any one decision," he writes.

A. Nelson Dingle, Sc.D.'45, writes, "Retired to our farm; growing a few Christmas trees; am serving on the Board of Directors of the Lutheran Social Services of Michigan." . . . **William R. Tahnk,** S.M.'73, joined TASC in March 1985 as a member of the technical staff in the Physical Sciences Division. . . . **Harvey S. Rosenblum,** S.M.'73, reports: "Graduated Tufts University School of Medicine (1979); did an internship at St. Elizabeth's Hospital of Boston (1979-80); did my residency in ophthalmology at New York Eye and Ear Infirmary (1980-83); and since then have a private practice in New York City." . . . **John H. Carlson,** '83, is presently with Merrill Lynch, New York City, specializing in capital markets—hedging and arbitrage trading strategy.

XIII OCEAN ENGINEERING

J. Kim Vandiver, Ph.D.'75, a specialist in the design of offshore structures, has been promoted to the rank of full professor in the department at M.I.T. In addition to his research and teaching on the dynamic response of structures to wave and current loads, Vandiver is director of the Experimental Study Group and will serve as associate chairman of the faculty for 1985-87.

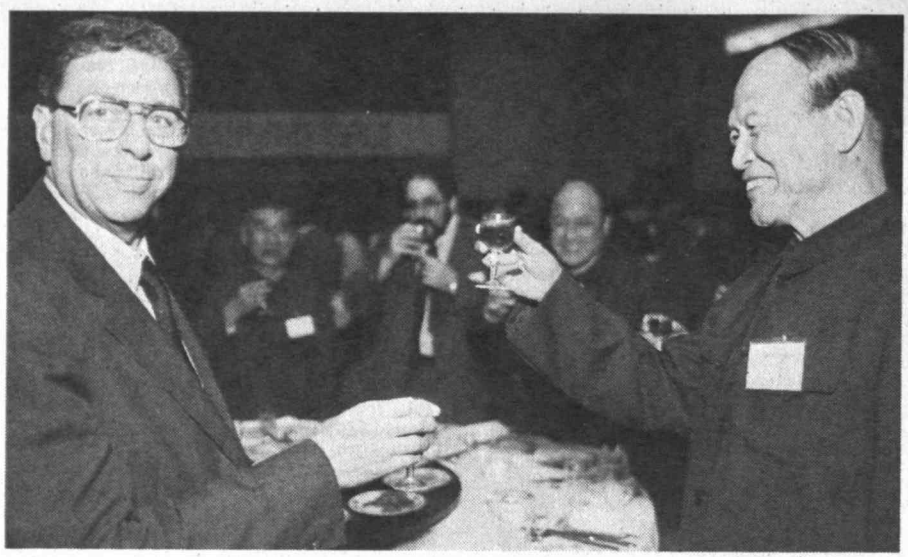
Charles E. Roth III, S.M.'66, is author of "Masterpieces," a jigsaw puzzle generator for the Apple MacIntosh, published by Hayden Software Co. . . . **Jennifer J. Zeien,** S.M.'80, has been promoted to associate with Booz, Allen & Hamilton, Arlington, Va. . . . **Richard C. Celotto,** S.M.'81, lieutenant commander, U.S.N., has transferred to the Naval Sea Systems Command, Washington, D.C., as project officer for the RACER program.

Two deaths have been reported to the Alumni Association, with no further details available: **David F. Kinert,** S.M.'42, rear admiral, U.S.N., Burlingame, Calif., in 1985; and **Richard K. Anderson,** S.M.'36, captain, U.S.N., Sumter, S.C., in 1985.

XIV ECONOMICS

Three distinguished alumni of the department were tapped for membership in the American Academy of Arts and Sciences late last spring: **George A. Akerlof,** Ph.D.'66, professor of economics at the University of California at Berkeley; **Carlos Frederico Diaz-Alejandro,** Ph.D.'61, professor of economics at Columbia University; and **Robert E. Hall,** Ph.D.'67, professor of economics at Stanford University and senior fellow at the Hoover Institution.

Oliver J. Blanchard, Ph.D.'77, whose work in



A toast to good fellowhip after a five-day conference at the Chinese Academy of Social Sciences in March on the role of foreign investment in Chinese development. Dean Abraham Siegel of the Sloan School (left) led a 19-man U.S. delegation (including 8 members of the M.I.T. faculty), while Ma Hong, president of the academy, brought 30 participants from Chinese agencies and institutions. (Photo: Owen D. Franken, '68, from Stock Boston)

macroeconomics has placed him at the top of his field, has been promoted to the rank of full professor at M.I.T. just two years after returning to the Institute from Harvard. Blanchard is currently a research associate at the National Bureau of Economic Research, and he is co-editor of the *Quarterly Journal of Economics*.

Professor **Peter A. Diamond,** Ph.D.'63, who was associate head of the department at M.I.T. for a number of years, has been named its head, succeeding Professor **Ann F. Friedlaender,** who is now dean of the School of Humanities and Social Science. Diamond returned to M.I.T. in 1966 to join the faculty after three years' teaching at the University of California in Berkeley, and he has compiled a distinguished record in the fields of taxation, social security, and uncertainty theory.

Jean M. Tirole, Ph.D.'81, associate professor in the department at M.I.T., has received a $25,000 research award from the Alfred P. Sloan Foundation for 1985-85. . . . Professor **Jerry A. Hausman,** also at M.I.T., has co-edited *Social Experimentation*, published by the University of Chicago Press, May 21, 1985.

XV MANAGEMENT

Leslie Clift Hruby, S.M.'73 (she also holds an S.B. (1969) from M.I.T. in economics) has joined with her husband, F. Michael Hruby, to found Technology Marketing Group, Inc., with offices in Acton, Mass. Their goal: "to bring results-oriented marketing to results-oriented firms." Before forming TMG, Leslie Hruby was for nine years with Digital Equipment Corp. in engineering, manufacturing, and marketing; her husband, who studied at Harvard Business School, had held a variety of marketing positions.

G. Mark Pomeroy, S.M.'82, writes, "Still in Kansas with General Electric Co. Now holding a program manager's position with profit-and-loss responsibility for a $6 million business. Lots of fun, but looking forward to transferring to Cincinnati by the end of 1985. For now, we're getting the ski boat ready for another summer in the Kansas sun!" . . . **Robert C. Salipante,** S.M.'81, reports that he and his wife Cathie had their second child, Paul Francis, born on March 24, 1985. . . . **Robert I. Heller,** S.M.'67, is an attorney in Seattle, Washington, with the firm of Riddell, Williams, Bullitt, and Walkinshaw.

Max Coutts, '39, writes, "Helped out on a successful alumni conference in Toronto in September 1984 (for Joe Martori and the National Alumni Conference Committee). My wife and I have just returned from a trip to Japan, Hong Kong, and Thailand, including a visit to the World's Fair at Science City in Japan. It was a great experience." . . . **Albert T. Camp,** S.M.'56, is studying the ability of goats' milk to help correct chronic disabilities caused by allergenic cow milk proteins. Camp owns and operates a model goat farm and complete dairy in eastern Maryland and is working with several physicians and hundreds of allergic people. . . . **William A. Shaffer,** Ph.D.'76, reports, "My partner and I have formed Software Design Group, Inc., Longwood, Fla., developers of software systems under contract in the financial services industries."

Management of Technology Program

Carol Lemlein, S.M.'83, called in April to announce that she had a promotion at Teradyne. She is now product manager for the J-983, a system for which she has been coordinating the software. Take a look at your latest Teradyne annual report—you'll see Carol pictured there! . . . **Kenneth W. Miller,** S.M.'82, called in May to say he and his family were making the move that month to Connecticut. His wife, Joan, had finished her executive M.B.A. program in North Carolina, so Ken will no longer have a commuter marriage. (I hope he will give us his new home address soon.) Ken and Joan were planning a trip to England in May and were hoping to reach **Geoff Andrews,** S.M.'82, at least by telephone.

Henry M. Montrey, S.M.'82, telephoned in May to share his sadness over Herbert Hollomon's death. (*See page A27 for obituary.*) Hank is traveling more than ever these days for Weyerhaeuser and said there were more organizational changes afoot for the company. Hank's oldest son has been accepted at Northwestern in journalism and hopes to start there this September.—Jane Morse, Program Manager, M.I.T., Room E52-125, Cambridge, MA 02139

XVII POLITICAL SCIENCE

Professor **Suzanne Berger,** in the department at M.I.T., has received a double honor: named the Ford International Professor of Political Science at M.I.T. and awarded a prestigious visiting professorshsip at the Ecole des Hautes Etudes en Sciences Sociales in Paris. Berger, a specialist in West European politics and political economy, has taught at M.I.T. since 1968 and held the William R. Kenan, Jr., Chair in 1972-74.

Eusebio M. Mujal-Leon, Ph.D.'80, writes, "On leave from my position as associate professor at Georgetown University and am a visiting fellow at the Center of International Studies at Princeton University (1984-86)." . . . **Jean Reith Schroedel,** Ph.D.'75, has written *Alone in a Crowd: Women in the Trades Tell Their Stories*, published last May by Temple University Press. The book is an oral history of three women who have entered the traditionally male-dominated world of the trades.

XXI HUMANITIES

Six members of the M.I.T. faculty in the humanities have been promoted to the rank of full professor: **Martin Diskin,** an authority on agrarian reform and mesoamerican peasantry in the fields of anthropology/archeology; **Kenneth R. Manning,** a leading scholar in the history of science who is associated with the Program in Science, Technology, and Society; **Travis R. Merritt,** whose special field is English prose literature; **Marcus A. Thompson,** violist and chamber music player of national reputation; **David Thornburn,** a founder of the discipline of television criticism; and **Barry Vercoe,** who as its director has brought M.I.T.'s Experimental Music Studio to a position of international prominence. Diskin is noted for his recent book, *Trouble in Our Backyard: The U.S. and Central America in the 80s*; Manning for his studies of the role of blacks in American science and technology; Merritt for his widely used text on *Style and Substance*; Thompson as a member of viola faculty at the New England Conservatory; Thorburn for his new book on television, *Story Machine*; and Vercoe for his contributions to computer music.

XXIV LINGUISTICS AND PHILOSOPHY

Professor **Richard L. Cartwright,** who was head of the Department of Philosophy for five years beginning in 1971, has now returned to be head of the Department of Linguistics and Philosophy. He succeeds Professor **Samuel J. Keyser,** who is now associate provost for educational policy and programs. Cartwright, at M.I.T. since 1967, is known for contributions to the philosophy of language and logic.

TECHNOLOGY AND POLICY PROGRAM

Dan Jones, S.M.'80, has accepted a position with the Mitre Corp., now that he has finished his tour with the U.S. Army. . . . **Adam Jaffe,** S.M.'78, has now completed his doctorate in economics at Harvard and will be staying on as an assistant professor. . . . **Janet Schaab (McLeary),** S.M.'80, has also finished her tour with the U.S. Army and will be working as a design engineer with Texas Instruments.

David Rubin, S.M.'83, has moved up to working with the San Francisco Public Utilities Commission in their Bureau of Energy Conservation. . . . **David Cheney,** S.M.'83, reports he has successfully worked with the U.S. Senate Commerce Committee on the passage of their Earthquake Hazards Reduction Act and Federal Fire Prevention and Control Act.—Richard de Neufville, Chairman, Technology and Policy Program, M.I.T., Room 1-138, Cambridge, MA 02139

J. H. Hollomon

J. Wulff

P. Rosenstein-Rodan

J. Herbert Hollomon, 1919-1985; Specialist in Technology Policy

J. Herbert Hollomon, '40, who had a distinguished career in materials science and later in technology policy, died in Albany, N.Y., while traveling on business on May 8; he was 66.

Dr. Hollomon received his doctorate in metallurgy from M.I.T. in 1946 and then joined General Electric Co., where he had increasing responsibilities in research management. His introduction to policy issues came in 1962, when he was chosen by President John F. Kennedy to be assistant secretary of commerce for science and technology. Six years later he embarked on a two-year term as president of the University of Oklahoma.

Hollomon returned to M.I.T. in 1970 to develop his concept for a Center for Policy Alternatives, a research and teaching effort of which he was founding director designed to delineate and present public policy options for dealing with technological change. He moved to Boston University in 1983, where he established a similar program as the Center for Technology and Policy.

Hollomon was a founding member of the National Academy of Engineering and was widely known in academic and policy circles; he and his associates were frequent contributors to *Technology Review*, and Hollomon served on this magazine's Advisory Board.

John Wulff, 1903-1985: Educator in Materials Science

John Wulff, professor emeritus of metallurgy whose professional work ranged over many fields of materials science, died in Mt. Auburn Hospital, Cambridge, on May 1; he was 82.

A native of New York, Professor Wulff studied mining at the Colorado School of Mines and physics at Yale and the University of Tuebingen, Germany, before coming to M.I.T. as instructor in physics in 1931. He transferred to the Department of Metallurgy in 1937 and nine years later became director of a new laboratory devoted to mechanical metallurgy. He was a widely published author on metal processing and held a number of patents in the fields of stainless steel, refractory metals, metallic powders, and friction materials. Finally, in the early 1970s Wulff combined his interests in metallurgy and orthopedic surgery to lead a project from which came a chromium-cobalt base alloy for surgical bone implants.

Though officially retired in 1968, Wulff continued as a senior lecturer at M.I.T. into the 1970s; he was widely acclaimed as a teacher, and he received special citations for his commitment to teaching from the AIME Metallurgical Society and the American Society for Metals.

Paul N. Rosenstein-Rodan, 1902-1985

Paul N. Rosenstein-Rodan, who was associated with research in political science and economics at M.I.T. for more than 15 years, died in Beth Israel Hospital, Boston, after suffering a heart attack on April 28. He was 83.

Rosenstein-Rodan came to M.I.T. in 1953 to work in the Center for International Studies on economic and policy development. Earlier he had taught at the Universities of Vienna (from which he received his Ph.D. in 1925) and London and then served as economic adviser to the International Bank for Reconstruction and Development. Rosenstein-Rodan joined the M.I.T. faculty in 1959; after retiring from M.I.T. in 1968, he taught at the University of Texas and later at Boston University.

One of the first major theorists in development economics, Rosenstein-Rodan is credited with coining the term "underdeveloped country." He consulted for the United Nations on development programs and also particpated in studies of U.S. foreign aid programs.

Thomas B. Drew, 1902-1985

Thomas B. Drew, '23, former professor of chemical engineering at M.I.T. and head of the department at Columbia University, died in Monadnock Community Hospital, Peterborough, N.H., on May 5 after a long illness. He was 83.

Professor Drew's contributions to chemical engineering education began at Drexel Institute of Technology in Philadelphia, where he was the first teacher of chemical engineering. In 1940 he moved to Columbia University for 17 years, then undertook overseas assignments for the Ford Foundation. He subsequently joined the M.I.T. faculty, retiring in 1970.

Professor Drew held the Walker Award (1937) of the American Institute of Chemical Engineers, and he was elected to the National Academy of Engineering in 1983.

Deceased

The following deaths have been reported to the Alumni Association since the *Review*'s last deadline:

Mrs. John Boyle, '01; 1985; Bellevue, Wash.
Mrs. James I. Banash, '06; 1985; Downey, Calif.
Mrs. George A. Dempsey, '13; 1985; Jaffrey, N.H.
Charles H. Chatfield, '14; May 12, 1985; West Hartford, Conn.
Robert Welles, '15; May 4, 1985; Pasadena, Calif.
Milton O. Schur, '16; July 6, 1984; Nashua, N.H.
Lawrence L. Clayton, '17; 1984; Jacksonville, Fla.
Samuel Harrison Chamberlain, Jr., '18; July 7, 1984; Plymouth, Mass.
Philip B. Craighead, '18; March 25, 1985; West Yarmouth, Mass.
Jorge Pena Polo, '18; February 16, 1985; Cali, Colombia.
Ervin M. Kenison, '19; 1985; Bradenton, Fla.
Russell H. Savage, '19; April 5, 1985; Riviera Beach, Fla.
E. Franklin Badger, '20; December 14, 1984; Fort Lauderdale, Fla.
Warren L. Chaffin, '20; February 20, 1985; Plymouth, Mass.
James H. Scott, Sr., '20; March 21, 1985; Richmond, Va.
Ernest S. Curtis, '21; 1983; West Palm Beach, Fla.
Trevor O.M. Davidson, '21; 1983; Milwaukee, Wisc.
Richard McKay, '21; February 8, 1985; Newton Center, Mass.
Donald W. Randolph, '21; April 16, 1985; Escondido, Calif.
Adrian E. Eckberg, Sr., '22; January 17, 1985; South Weymouth, Mass.
Edward C. Fales, '22; March 25, 1985; Salisbury, N.H.
Frederick A. Higgins, '22; April 20, 1984; Andover, Mass.
James R. Morton, '22; March 9, 1985; Bethesda, Md.
Abraham G. Silverman, '22; December 12, 1984; McLean, Va.
Ronald D. Brown, '23; May 15, 1985; Lexington, Mass.
Roy T. Cowdrey, '23; 1982; Fort Lauderdale, Fla.

Clyde B. Doolittle, '23; February 22, 1985; Hillsdale, N.J.
Thomas B. Drew, '23; May 5, 1985; Peterborough, N.H.
William J. O'Shaughnessey, '23; July 22, 1984; Macon, Ga.
Clinton B. Conway, '24; April 11, 1985; Altoona, Fla.
Robert Bruce Lindsay, '24; February 2, 1985; Providence, R.I.
Mrs. Sidney W. Andrews, '25; January 25, 1985; South Salem, N.Y.
Alexander C. Brown, '25; January 13, 1985; Cincinnati, Ohio.
George L. Burns, '25; 1984; Portland, Ore.
Frederic S. Jacques, '25; March 22, 1985; Bangor, Maine.
Augustine J. Cotter, '26; 1984; Searsport, Maine.
Valentine F. Harrington, '26; 1985.
Richard L. O'Donovan, '27; April 23, 1985; Coral Gables, Fla.
Helmuth G.R. Schneider, '27; February 25, 1985; Westfield, N.J.
Darcy A. Young, Jr., '27; November 24, 1984; Peterborough, N.H.
Alexander B. Daytz, '28; December 1984; Chatsworth, Calif.
Mrs. David Mathoff, '28; 1985; Boston, Mass.
Harold G. Nyman, '28; June 2, 1984; Belmont, Mass.
Walter R. Ramsaur, '28; May 11, 1984; Pacific Palisades, Calif.
Joseph D. Riley, '28; March 19, 1985; Lighthouse Pt., Fla.
Francis C. Sweeney, '28; March 15, 1985; Clifton, N.J.
Charles B. Bacon, '29; April 30, 1985; Middletown, Conn.
William E. Lowery, '29; November 29, 1984; Plymouth, Mass.
Henry S. Muller, '29; March 26, 1985; Belmont, Ohio.
Henry N. Bates, '30; January 1985; Los Gatos, Calif.
Thomas J. Hickey, '30; January 18, 1985; Arlington, Va.
Jonathan G. Swift, '30; January 18, 1985; West Hartford, Conn.
Albert Earl Cullum, Jr., '31; January 31, 1985; Dallas, Tex.
Joseph H. Passell, '31; March 15, 1985; Williamston, N.C,
Ira J. Bach, '32; March 6, 1985; Chicago, Ill.
Edwin C. Beck, '32; May 31, 1984; Muskegon, Mich.
Harry F. Carlson, '32; August 31, 1984; Hanover, Mass.
Maurice D. Triouleyre, '32; April 26, 1985; Longmeadow, Mass.
Joseph Welch, Jr., '32; April 13, 1985; Fort Lauderdale, Fla.
Weston L. Brannen, '33; March 14, 1978; Valparaiso, Ind.
J. Mason Culverwell, '33; November 3, 1984; Washington, D.C.
Leo V. Dewar, '33; November 5, 1984; Rochester, N.Y.
John R. Hopkins, '33; March 16, 1985; Los Alamos, N.M.
Kenneth D. Moslander, '33; February 1985; Fort Myers, Fla.
Robert N. Eck, '34; March 29, 1985; Brookfield, Wisc.
Walter R. Hedeman, Jr., '34; April 14, 1985; Annapolis, Md.
Octavio Leonard Colavecchio, '35; April 2, 1985; Providence, R.I.
Dwight P. Merrill, '35; December 27, 1984; Newton, Mass.
Joseph I. Ackerman, Jr., '36; May 9, 1985; Arlington, Mass.
Wilber W. Haynes, '38; 1985; Kissimmee, Fla.
Alfred Sweeney, Jr., '38; December 13, 1984; Santa Barbara, Calif.
Robert G. Larkin, '39; February 15, 1985; Ventura, Calif.
Ramon S. Sevilla, Sr., '39; April 1, 1985; Metro Manila, Philippines.
Ernest G. Chilton, '40; January 22, 1985; Menlo Park, Calif.
David Joseph Collins, '40; April 13, 1985; Wellesley, Mass.
J. Herbert Hollomon, '40; May 8, 1985; Brookline, Mass.
Spencer M. Richardson, '40; May 26, 1984; Quakertown, Penn.
Richmond W. Wilson, '40; February 7, 1985; Corning, N.Y.
Richard H. Gould, Jr., '41; 1982; Douglaston, N.Y.
Floyd W. Iden, '41; June 27, 1984; Pompton Plains, N.J.
Robert P. Boyer, '42; December 4, 1984; Manchester, Tenn.
Joseph A. Crutcher, '42; April 1985; Fullerton, Calif.
Wesley R. Floyd, '42; February 29, 1984; Bradenton, Fla.
Ray O. Wyland, Jr., '42; April 1, 1985; Tujunga, Calif.
Margaret L. Blizard, '43; May 10, 1985; Norwood, Mass.
Clyde A. Booker, Jr., '43; 1985; Pittsburgh, Penn.
Shao T. Hsu, '43; 1985; Bethesda, Md.
James B. Hoaglund, '45; February 9, 1985; Minneapolis, Minn.
David A. Trageser, '45; April 26, 1985; Wayland, Mass.
William H. Auerswald, '46; April 10, 1985; Suffield, Conn.
Jacob W. Ullmann, '46; February 5, 1985; New York, N.Y.
Helmar Schlein, '47; February 19, 1985; Reseda, Calif.
John F. Christopher, '48; April 24, 1985; St. Louis, Mo.
Ralph Segal, '48; January 1985; Roslyn, N.Y.
David S. Selengut, '48; July 24, 1984; Schenectady, N.Y.
Hendrie J. Grant, '49; August 1, 1984; St. Paul, Minn.
Leonard N. McKibben, '49; December 31, 1984; Westlake, Ohio.
Walter E. Mutter, '49; November 1984; Poughkeepsie, N.Y.
Meir Drubin, '50; April 25, 1985; Rancho Palos Verde, Calif.
Robert S. Lovett, '50; June 1984; Wilmington, Del.
Dean E. Cogswell, '51; May 11, 1985; Wenham, Mass.
Bryant W. Foster, '51; March 17, 1985; Braintree, Mass.
Charles G. Etter, Jr., '53; December 22, 1983; Wayne, Penn.
Lawrence Tsun-Ying Kwan, '53; December 1967; Encino, Calif.
Alan K. MacKenzie, '54; April 10, 1985.
Tse H. Chu, '55; March 1982.
Agnes M. Galligan, '55; 1985; West Roxbury, Mass.
Jakob Auslaender, '56; February 5, 1985; Chicago, Ill.
Walter C. Kottemann, '59; May 5, 1984; Clarendon Hills, Ill.
Vinod Sundra, '59; December 20, 1980; Bedford, Mass.
Michael Vincent Bogda, '66; May 22, 1983; Woodland Hills, Calif.
Paul G. Maguire, '68; April 4, 1984; Acton, Mass.
Theodore R. Steger, Jr., '74; 1985; Longmeadow, Mass.

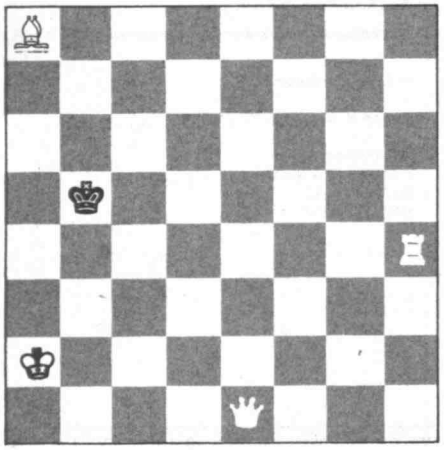
ALLAN J. GOTTLIEB

Midsummer Snowstorm

Our group is just now moving to a newly renovated floor. We had a major influence in specifying the layout, and it is satisfying to see how well it all works. I guess that if our research efforts into computer architecture turn out to fizzle we have a related field to move into.

Problems

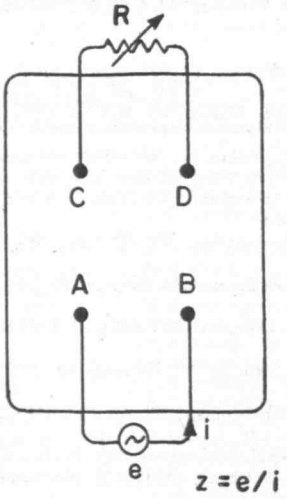
A/S 1. Here is a chess problem from *The Tech*, M.I.T.'s student newspaper. White is to move and force a mate in two:



A/S 2. Another geometry problem from Phelps Meaker, who writes:
I wanted an approximation of a four-foot sphere for light-integration measurement. I made a dodecahedron of sheet metal, except that instead of flat surfaces, I substituted low five-sided pyramids. It served my purpose. How should I have designed the pyramids so that all the dihedral angles were equal?

A/S 3. Randy Barron poses a question that should appeal to all EE majors:

A four-port device contains only passive linear circuit elements. Using a fixed-frequency sine-wave generator, you can measure the complex impedance Z between two of the terminals, A and B. A variable resistor R is connected across the other two terminals, C and D. What is the locus in the complex plane traced out by Z as R varies from zero (short circuit) to infinity (open circuit)?



A/S 4. Here is a temporal cryptarithmetic problem from Nob Yoshigahara relayed to me via Richard Hess (on DICKNET interpuzzler communication network):
Fill in the boxes with the digits 1,2,3...,9:
□□^{min}:□□^{sec} × □ = □□^{min}: □□^{sec}

A/S 5. An out-of-season problem from Bruce Calder:
It began to snow on a certain morning, and the snow continued to fall steadily throughout the day. At noon, a snowplow started to clear a road at a constant rate in terms of the volume of snow removed per hour. The snowplow cleared two miles by 2 p.m. and one more mile by 4 p.m. At what time had the snowstorm begun?

Speed Department

SD 1. Greg Huber sent us the following problem, told to him by Douglas Hofstadter:
Simplify the product
$(x - a)(x - b) \ldots (x - z)$.

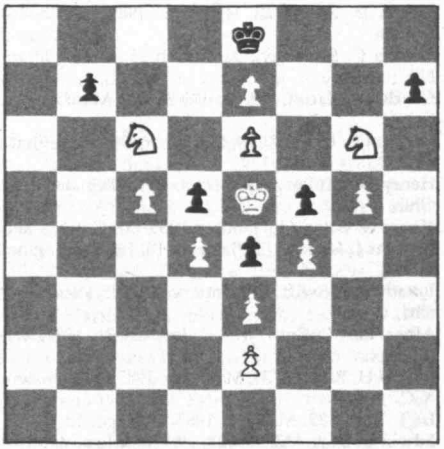
SD2. Doug Van Patter offers a bridge quickie:

North:	*East:*
♠ K 9 3	♠ 10 7 6
♥ 6 5 3	♥ A K Q 7
♦ A J 9 2	♦ Q 7 5
♣ Q 7 4	♣ J 10 9

You are East in a rubber bridge game; bidding has gone: South 1NT, North 3NT. Your partner leads the ♥10, and everyone follows to three rounds of hearts. What is your best shot at setting this game?

Solutions

APR 1. White is to play and mate in two:



Jerry Grossman sent us the following solution:
White moves g5-f6 (en passant), then f6-f7 (checkmate) after any reply by Black. To prove that this solution is correct, we first claim that Black's previous move was either d7-d5 or f7-f5. These are clearly the only pawn moves possible (since the White king could not have been in check when Black moved), but why couldn't the Black king have moved to its present position on the last move to escape check? It couldn't have come from d8 or f8, since there would have been no way for White to administer the double check (pawn at e7 and knight). On the other hand, if the Black king came from d7 or f7, then White would have had to have moved the pawn to e6 on the previous move but there is no now-vacant square from which this pawn could have come. Thus we have verified this first claim. Now, in order for White's pawns to be in the position they are in, they must have made at least 10 captures. Black is missing only 10 pieces, however, and hence every one must have been captured by a pawn. If Black's last move was d7-d5, then Black's queen bishop could not have ever moved and could not have been captured by a pawn. This contradiction proves that Black's last move could only have been f7-f5, and thus the so-

SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, ASSOCIATE RESEARCH PROFESSOR AT THE COURANT INSTITUTE OF MATHEMATICAL SCIENCES, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y., 10012.

lution announced above provides the only mate in two.

Also solved by Jeffrey Mattox, John Bobbitt, Matthew Fountain, and Neil Hochstedler.

APR 2. Note that each of the following is a different way of evaluating the same equation:
16601.92 + 14374.08 =
11334.4 + 19641.6 =
18521.44 + 12454.56 =
4147.36 + 26828.64 =
Write the equation in the usual form.

John Bobbitt was able to recognize the hidden quadratic and writes:
The four "sets of numbers" represent
$a^2 + 2ab + b^2 = (a + b)^2$
where a = 111.6 and b = 64.4. By forming different groupings of the four terms a^2, b^2, ab, ab, we can get the four sets. Thus,
$(a^2 + b^2) + 2ab = (a + b)^2$
$(ab + b^2) + (ab + a^2) = (a + b)^2$
$(b^2 + 2ab) + a^2 = (a + b)^2$
$b^2 + (a^2 + 2ab) = (a + b)^2$

Also solved by Harry Zaremba, Jerry Grossman, Marshall Fritz, Matthew Fountain, and Winslow Hartford.

APR 3. Find all maxima and minima of

$$\frac{\ln\left(1 + e^{-x} + \frac{x}{2}\right)}{\ln\left(1 + e^{x} - \frac{x}{2}\right)}$$

without using calculus.

The solution below is from George Bird:
Note that the expression $(1 + e^{-x})$ may be written as $(1 + 1/e^x)$. Use the second form of this expression and write it as a fraction with the common denominator e^x, thus:
$(e^x + 1)/e^x$
If we substitute this form, the expression
$\ln(1 + e^{-x})$ becomes:
$\ln(1 + e^x) - \ln(e^x)$.
The function
$[\ln(1 + e^{-x}) + x/2]/[\ln(1 + e^x) - x/2]$
then becomes:
$[\ln(e^x + 1) - \ln(e^x) + x/2] / [\ln(1 + e^x) - x/2]$,
which reduces to 1/1. Therefore there are infinitely many maxima and minima, and all have value 1.

Also solved by Allen Tracht, Edwin McMillan, Harry Zaremba, Howard Stern, J. Richard Swenson, Jerry Grossman, John Bobbitt, John Prussing, Ken Haruta, Marshall Fritz, Matthew Fountain, Mike Hennessey, Naomi Markovitz, Peter Card, Ross Hoffman, Steve Feldman, Steve Silberberg, Tony Trojanowski, Winslow Hartford, and the proposer, Rick Decker.

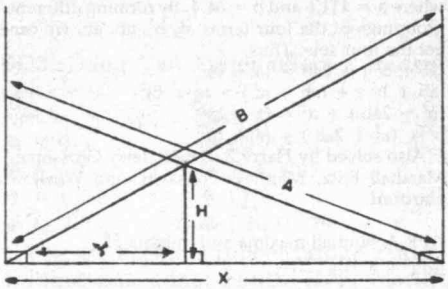
APR 4. On each day of the year (not leap year) you are given a penny. On December 31 you are given your last penny and told that it was fresh from the U.S. Mint, but that one of the previous pennies may have been counterfeit, and therefore lighter or heavier than the standard penny. You are asked to determine the number of balancings, using a common pan balance, that would be necessary and sufficient to determine whether or not there is a counterfeit coin, and if there is, to tell whether it is heavier or lighter than the last penny that you received.

The following solution is from Leon Tabak:
Two balancings are necessary (clearly) and sufficient for determining which of three possible solutions is the true situation:
(1) all coins are genuine.
(2) one coin is counterfeit and it is lighter that all of the other (genuine) coins.
(3) one coin is counterfeit and it is heavier that all of the other (genuine) coins.
Divide the set of 364 coins (whose genuineness is not known) into three sets: S1, S2, and S3. Let S1 contain 122 coins. Let S2 and S3 each contain 121 coins. A fourth set, G, contains the one certified, genuine coin.
First measurement: Place S1 in the left pan of the scale. Place S2 and G on the right side of the scale. If the two balance, then all of the coins in S1 and S2 must be genuine and the counterfeit coin, if there is one, must be in S3. The possibilities that remain

if the two pans balance in this first measurement are:
(1) all coins are genuine.
(2) S3 contains an extra-light counterfeit coin.
(3) S3 contains an extra-heavy counterfeit coin.
If the right pan comes to rest at a lower level than the left pan, then two possibilities remain:
(1) S1 contains an extra-light counterfeit coin.
(2) S2 contains an extra-heavy counterfeit coin.
In either case, all of the coins in S3 must be genuine. (There is at most one counterfeit coin, and this test has shown that it must be in S1 or S2).
Second measurement: Place S1 in the left pan. Place S3 and G in the right pan. If the scale balances on the second measurement and it also balanced on the first measurement, then all coins are genuine. If the left pan is higher, but the scale balanced during the first measurement, then S3 must contain an extra-heavy counterfeit coin. If the left pan is lower, but the scale balanced during the first measurement, then S3 must contain an extra-light counterfeit coin. If the scale balances on the second measurement, but the left pan rested lower during the first measurement, then S2 must contain an extra-light counterfeit coin. If the scale balances on the second measurement, but the left pan rested higher during the first measurement, then S2 must contain an extra-heavy counterfeit coin. If the left pan is lower and the left pan was also lower during the first measurement, then S1 must contain an extra-heavy counterfeit coin. If the left pan is higher and the left pan was also higher during the first measurement, then S1 must contain an extra-light counterfeit coin. Two outcomes are inconsistent with the statement of the problem. The left pan cannot be higher in the first measurement and lower in the second, nor can it be lower in the first and higher in the second. Either outcome would imply the existence of more than one counterfeit coin.

Also solved by Rik Anderson, Dudley Church, E.P. Schacht, Frederic Jelen, Harry Zaremba, John Prussing, John Spalding, Kenneth Olshansky, Matthew Fountain, Phelps Meaker, Walter Cluett, and the proposer, Alan Faller. Mr. Faller also showed that with six balancings, one can also determine which coin was counterfeit (except for leap years when seven are required). Copies of Mr. Faller's solution are available upon request.

APR 5. Find X for two configurations—when A = 15, B = 10, and H = 8; and when A = $16 + 2\sqrt{2}$, B = $16 - 2\sqrt{2}$, and H = 2.



Howard Stern's solution is one of the few in which an exact solution was found for the second configuration:
With the above lengths labelled, similar triangles give the following relationships:
$(\sqrt{B^2 - X^2})/X = H/Y$
$(\sqrt{A^2 - X^2})/X = H/(X - Y)$.
Eliminating Y yields:
$1/(\sqrt{B^2 - X^2}) - 1/(\sqrt{A^2 - X^2}) = 1/H$ (1)
The left side of (1), viewed as a function of X, has a minimum of (1/A)+(1/B) when X = 0 and increases with X. For the first set of parameters given (A = 15, B = 10, H = 8), the left hand side of (1) will always be greater than 1/6 = 1/15 + 1/10. But the right hand side is 1/8. Therefore, (1) can never be satisfied; so these "crossed ladders" represent an impossible configuration. The highest point of crossing is 6, never 8.

The second set of parameters do allow for a physically possible solution. After substituing A = $16 + 2(2)^{1/2}$, B = $16 - 2(2)^{1/2}$ and H = 2 in (1), the solution is X = $(168)^{1/2} = 12.96$.

Also solved by Allen Tracht, Avi Ornstein, Frederic Jelen, Harry Zaremba, Matthew Fountain, Peter Card, Ross Hoffman, Steve Feldman, Winslow Hartford, and the proposer, Martin Brock.

Better Late Than Never

1984 N/D 1. Neil Hochstedler notes that the third move in the third variation should be Q-a4 mate.

1985 JAN 3. Randall Whitman has responded.

F/M 3, F/M 4. George Parks has responded.

APR SD2. E.P. Schact wants to rescind Horton's Nobel Prize believing that the *chicken* came first.

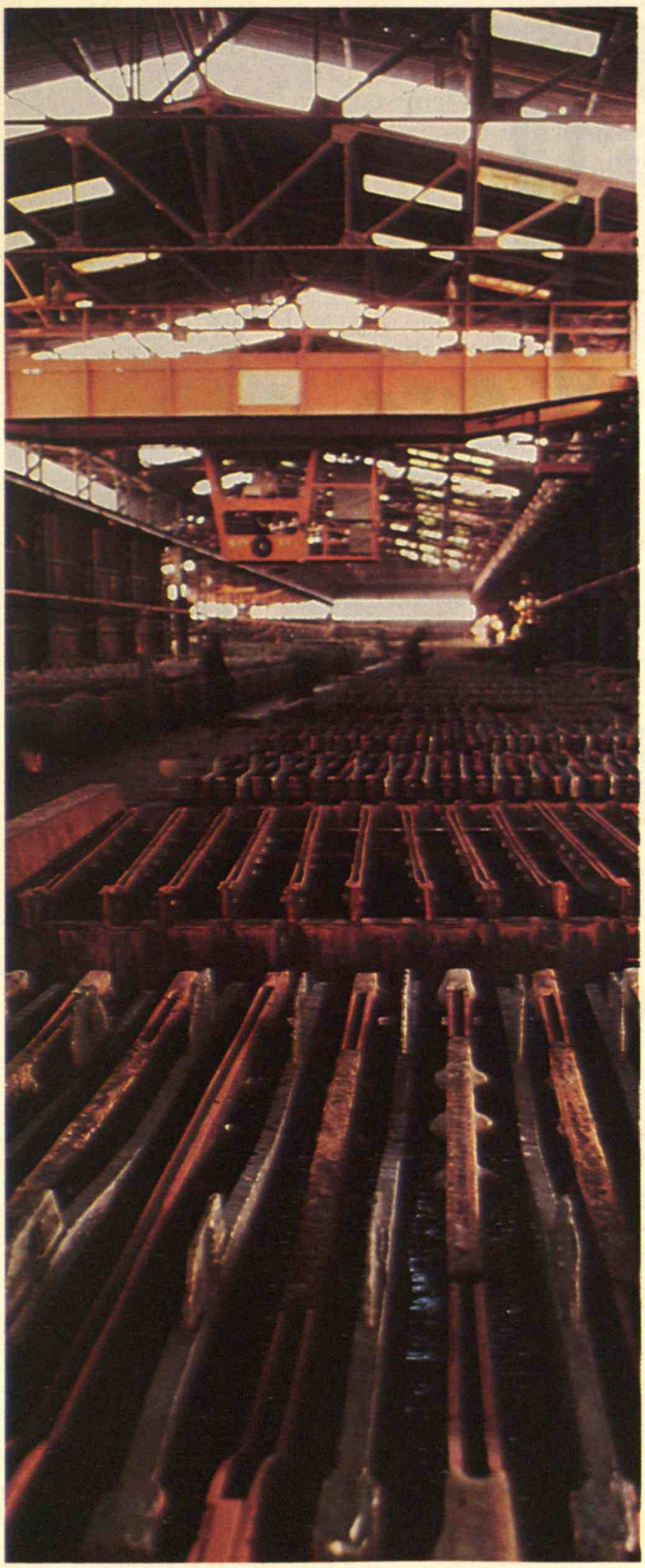
Proposer's Solutions to Speed Problems

SD 1. Zero.

SD 2. Don't cash your fourth heart! Lead a club and trust that declarer now thinks that it is safe to take the club finesse into your hand.

	♠ K 9 3 ♥ 6 5 3 ♦ A J 9 2 ♣ Q 7 4	
♠ J 5 4 2 ♥ 10 9 8 ♦ 8 6 3 ♣ 8 6 5 3		♠ 10 7 6 ♥ A K Q 7 ♦ Q 7 5 ♣ J 10 9
	♠ A Q 8 ♥ J 4 2 ♦ K 10 4 3 ♣ A K 3	

In the massive copper mines of Zaire, cobalt is separated from copper ore by electrolysis. The ore is dissolved into aqueous salts of copper and cobalt between rows of huge electrode plates (below). When voltage is applied to this solution, adding a certain number of electrons, the cobalt becomes insoluble and coats the plates in solid form. The cobalt is then peeled off the plates by a huge crane, and the copper that remains behind is processed separately.



produces no manganese but has considerable domestic reserves of low-quality manganese, which is not now used in steel making.

Policymakers are not overly concerned about near-term supplies of this mineral because even South Africa accounts for only about 20 percent of total world production, and each of the other major producers accounts for less than 10 percent. Under these conditions, it is doubtful that a supply disruption could cut off a large portion of our needs.

However, as manganese mines in Brazil, Australia, and Gabon are depleted, there may be greater cause for concern. By the year 2000, the developed countries may depend upon only two major suppliers of manganese: South Africa and the Soviet Union. On the other hand, many options for conservation and substitution are available should manganese prices escalate.

For instance, if its price were to double, steel makers could economically reduce the amount of manganese they add to blast furnaces by about .05 percent. That would yield a savings of about one pound of manganese per ton of steel. The savings could be achieved by installing robots that could feed manganese to the furnace in fixed, precise quantities. Manufacturers could also reduce the amount of manganese they use to remove sulphur in making some carbon and alloy steels.

Still, substitution options are more limited for manganese than for other critical metals. Thus, if the price of manganese ore should double, consumption by the U.S. steel industry would decrease by only about 10 percent in the first year, and by up to 15 percent in five years, if steel production remained constant.

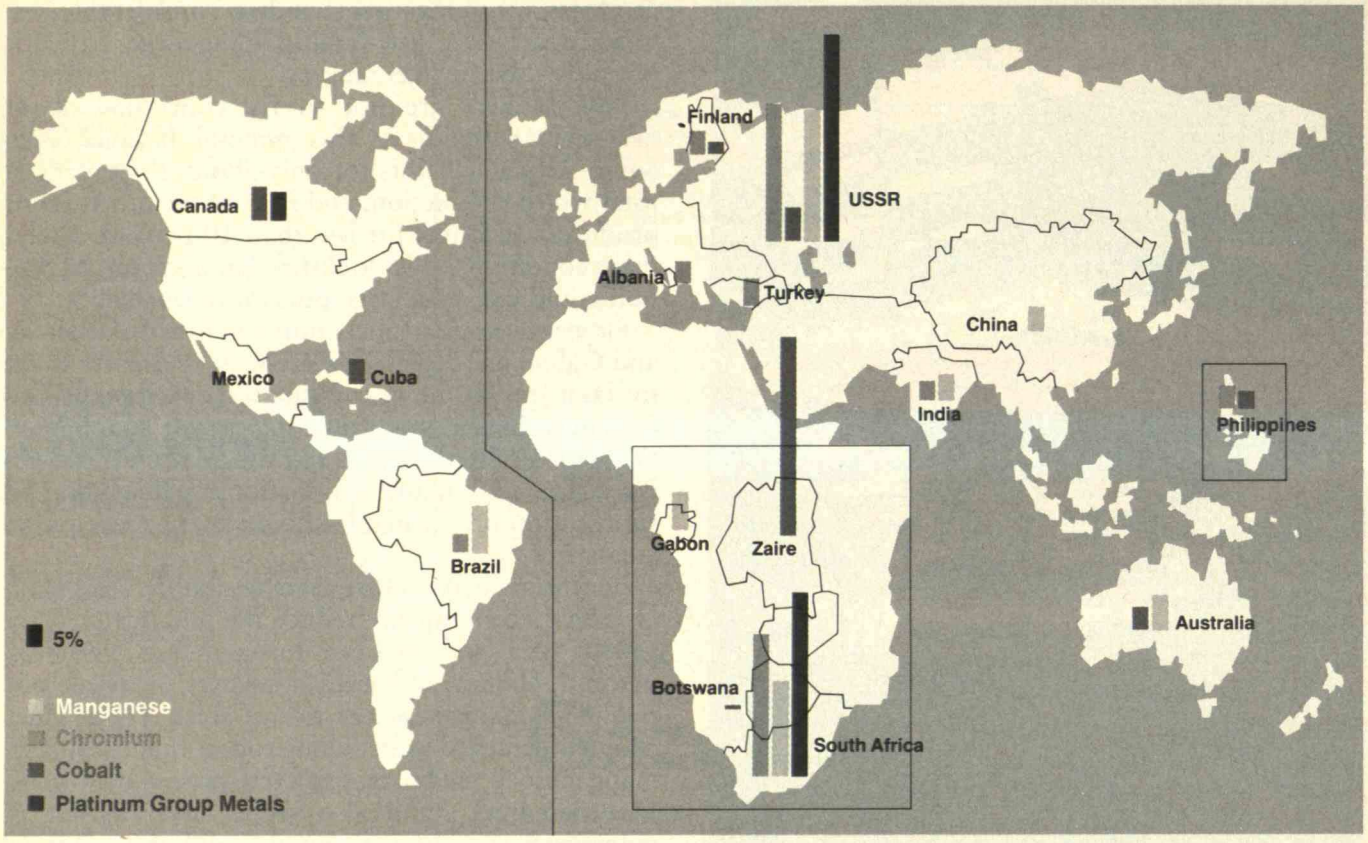
How Precarious Is the Supply of Cobalt?

Like manganese and chromium, cobalt is considered strategic because of its importance in defense munitions. It is used in superalloys for high-temperature parts of jet engines and industrial gas turbines, and to take sulphur out of oil in refining petroleum. It is also used as a binder material in cutting tools and as an alloying element in steel.

Because the United States imports virtually all its cobalt from countries with potentially unstable political regimes, this metal is considered critical in a way that manganese and chromium are not. Zaire, the dominant producer, accounts for 50 to 60 per-

PHOTO: ALEX WEBB, MAGNUM

The United States imports well over $1 billion worth of critical metals. South Africa is a major supplier of three of the most important: chromium, manganese, and platinum. The Soviet Union also has large reserves of these three metals, but East-West trade in them has historically been minimal. Zaire, meanwhile, harbors more than half the world's cobalt reserves.



cent in most years. Zambia, which like its neighbor Zaire recovers cobalt when producing copper, is the next largest producer. Canada, the Philippines, Australia, Indonesia, New Caledonia, and Botswana all recover smaller amounts of cobalt as a by-product of nickel mining and processing.

Zaire has experienced major problems in producing and exporting cobalt during the last 10 years. Combatants in Angola's civil war temporarily cut the railroad from Zaire through Angola to the Atlantic in 1975. In 1978, Katangan rebels invaded the cobalt-producing Shaba provinces in a revolt against the ruler of Zaire. Though the damage to mining facilities was slight, virtually all foreign workers fled and the facilities fell into disrepair. In addition, low copper prices have left Zaire almost bankrupt, hindering it from maintaining its transportation network and copper and cobalt factories.

However, the cobalt situation may not be as precarious as this description suggests. A recent study by Charles River Associates, a Boston-based economics consulting firm, shows there is considerable elasticity in world demand. When the price of cobalt increased dramatically from 1978 to 1980, consumption dropped sharply.

Materials such as nickel can be substituted for cobalt in many uses, including jet engines—usually at somewhat higher prices and with slight changes in performance. Increases in cobalt prices also encourage recycling and conservation.

That is indeed what occurred when the 1978 Katangan invasion of Shaba disrupted supplies. Manufacturers used alternative materials and other sources increased supplies, forcing Zaire to lower its set price from $55 per kilogram to less than $22 per kilogram in 1982. The price decreased even further to about $11 per kilogram early in 1983.

According to our estimates, if the price of cobalt were to return to the high levels of 1978, demand would drop by 50 percent in a few years. Thus, a disruption of cobalt supplies from Zaire would not affect U.S. national security, especially since stockpiles could be used to cover short-term shortages.

A similar case can be made for platinum-group metals (PGMs), which include platinum, palladium, and iridium. These metals are essential in catalytic

MAP: OMNIGRAPHICS

In today's world, it is virtually impossible to shut off any one country from access to critical materials.

uses, petroleum refining, chemical processing, and treating automotive exhaust. For instance, platinum is the catalyst in the converter used to control automotive pollution. PGMs are also used in telecommunications switching systems (as contacts and electrodes in ceramic capacitors), as well as in jewelry and medical and dental equipment. The United States imports 49 percent of its platinum from South Africa, 15 percent from Canada, and 13 percent from the Soviet Union.

Charles River Associates recently predicted that if the price of platinum saw large, sustained increases, the U.S. government would relax pollution controls on car exhaust. If that happened, automakers would reduce their platinum consumption by at least 75 percent. In chemical processing, any major increase in price would provoke major increases in platinum recycling, and consumption in this area would drop by about 30 percent. A supply disruption would also have minimal effect on the telecommunications industry, since it already plans to recycle much of its electronics equipment over the next two decades. Futhermore, Charles River Associates estimates that gold would rapidly supplant platinum in dental uses if its price were to increase, although the rate of substitution would depend on the price of gold at that time.

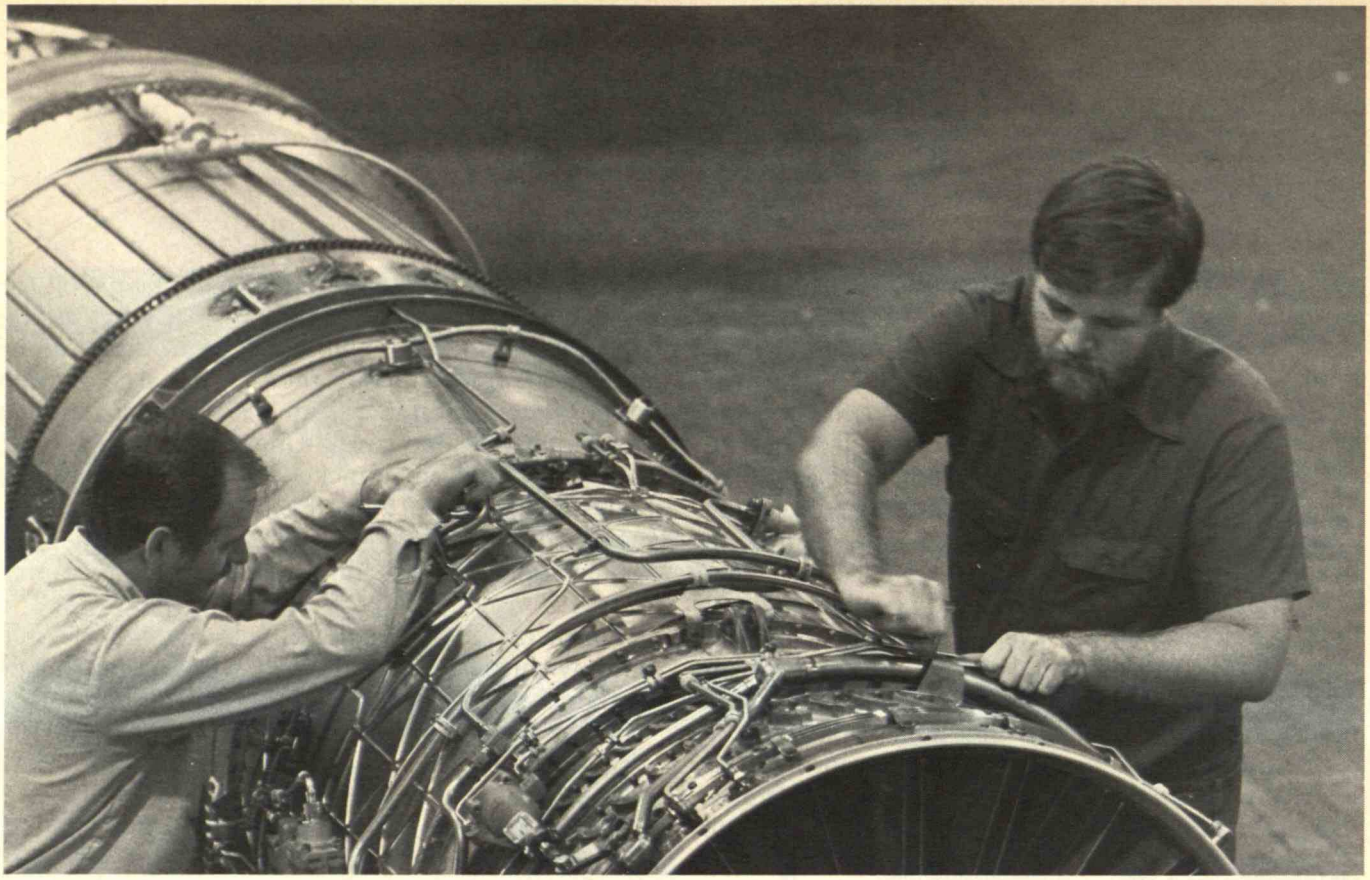
The Chances of Calamity

What would happen if a politically unstable producer failed to supply a critical material to the United States for five years? And worse, what if a successful boycott by other countries, such as those in the Soviet bloc, cut off U.S. access to alternative resources?

To begin with, the likelihood that a disruption would continue for five years is very low because political regimes and alliances constantly change. And the probabilility of a "cataclysmic" disruption is virtually nil. The failure of the Arab nations to choke off oil exports to developed countries in the early 1970s vividly supports this point. Other punitive trading policies that failed include the U.S. embargo of grain to the Soviet Union in the late 1970s, the Rhodesian chromium embargo to the United States in the late 1960s, and the Cuban nickel embargo to the United States in the early 1960s. Each of these embargoes increased the cost of the materials, but none prevented them from reaching any country that wanted them.

For instance, even though the United States could not buy chromium directly from Rhodesia during its embargo, we simply purchased it from South Africa, which continued to buy the ore from Rhodesia. It is virtually impossible to shut off any one country from access to the materials market.

Of course, disruptions may have serious short-term effects, particularly in the form of increased costs to manufacturers. That is why we urge the U.S.



government to maintain its present stockpile to protect military needs, and to cushion the shock to the private sector while it changes its consumption and production patterns. However, we see no need to greatly increase stockpiles to cover nonmilitary needs. Current supplies of platinum, for example, total 1.437 million ounces, with a market value of $350 million. But defense needs account for only 5 percent of U.S. platinum consumption. A platinum stockpile large enough to cover nonmilitary needs for five years would cost over $7 billion—an outrageous economic burden. Similarly, the cost of providing a civilian stockpile for cobalt would be $1.2 billion.

The Danger of Political Misalliances

The OTA and other analysts have urged the United States to form stronger alliances with nations that supply critical materials. This means tying such nations closer to us with trade privileges, foreign aid, weapons sales, and treaties. However, this approach presents an unsavory prospect: stronger U.S. alliances with governments whose policies are antithetical to our own.

The most compelling example, of course, is South Africa. Late in 1980, Joseph Churba, a Reagan advisor, accused the previous administration of "criminal neglect" in failing to recognize South Africa's critical importance as a supplier of strategic materials. He urged the president to end the U.S. arms embargo against South Africa and to set up a naval presence there. While not going to that extreme, the Reagan administration has pursued a policy of "constructive engagement" in an attempt to improve relations with that country while exerting subtle pressure for reform.

Recently, however, this policy has unraveled because of the overly repressive attempts by the South African government to put down domestic unrest. In June, the United States recalled its envoy to South Africa, and Congress has renewed calls for economic sanctions against South Africa. That country, in turn, has threatened an embargo on critical metals to the United States if it imposes such sanctions.

In our view, this is an empty threat since the United States can obtain these critical metals elsewhere—albeit at somewhat higher prices. And South Africa must continue selling these metals to someone if it wants to preserve the health of its economy. More important, forging closer ties with a nation that practices overt racial discrimination would be disastrous to U.S. international relations. The political damage from such a self-serving policy would far outweigh the potential economic benefits.

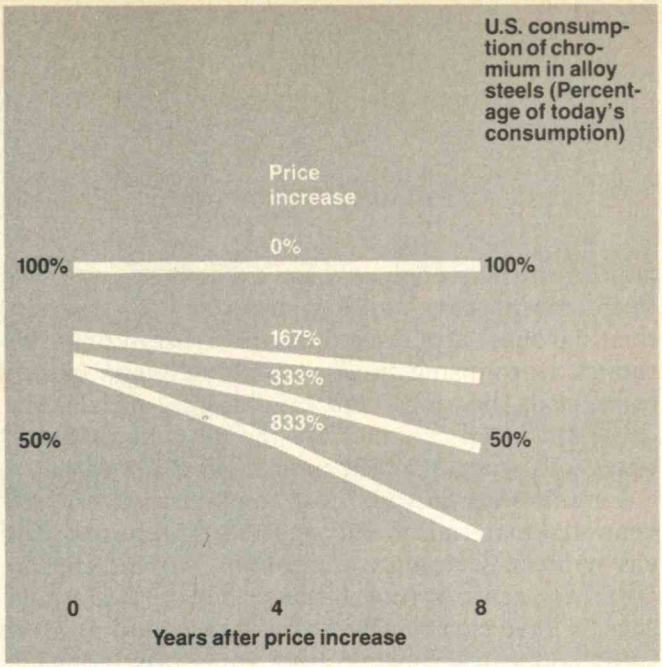
Exploiting New Resources

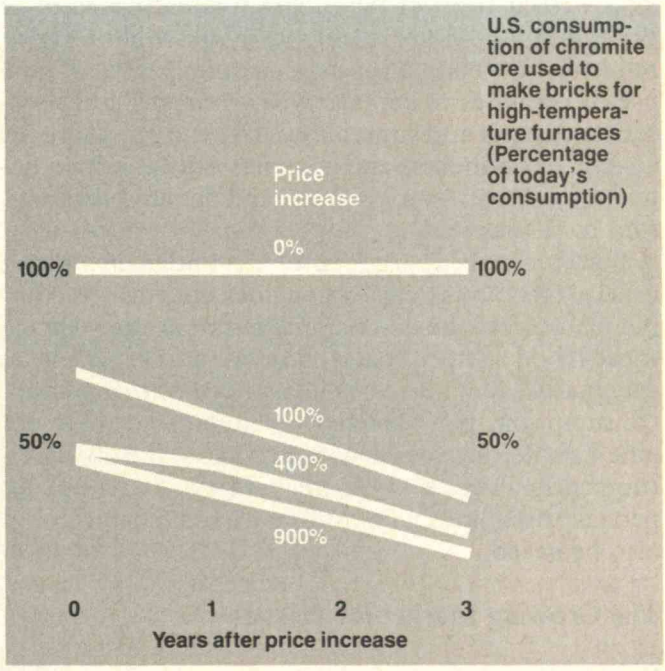
Two types of unexploited resources could help this country respond to a crisis in critical materials. The

PHOTO: PRATT & WHITNEY

Left: Engineers put the final touches on a jet engine made of superalloys, which are resistant to high temperatures and contain imported cobalt, nickel, and titanium.

Right: The U.S. imports 82 percent of its chromium. But if supplies were disrupted, industry could turn to other materials. Thus, an increase in the price of the chromium used in metal alloys would cut consumption (top). The same effect would occur for chromite ore, used in high-temperature bricks (bottom).





first are the low-grade, land-based ores in the United States and friendly nations that cannot profitably be extracted at today's prices. The second are the mineral resources that we know exist or may discover in the deep sea. Of these, the manganese nodules in the Pacific are the best known. But like the low-grade land-based ores, extracting them is not economical at current prices and with today's technology.

Would-be producers of these resources are caught in a Catch-22 situation. On one hand, they must wait until scarcity drives up the price of strategic materials before trying to exploit them. But once they make that investment of time and money and the strategic materials reach the market, scarcity-driven prices will fall. This dilemma is particularly acute in the case of deep-sea mining projects, where large quantities—especially of cobalt—could be produced, driving the price to very low levels.

One way to overcome this dilemma, and encourage companies to invest in technology for exploiting these resources, is for the government to guarantee prices for the manganese and cobalt that would be produced. But such an approach would be very costly, since the government would be committed to purchasing materials at above-market prices.

As a less costly alternative, the government could further explore the known reserves of land-based low-grade ores in Idaho, California, and Missouri. This effort would not likely discover any "mother lode," but added domestic reserves—even if unexploited—would allow for more rational policies and a reduced sense of dependence on foreign sources. Rather than directly funding this kind of exploration, the Reagan administration has concentrated on removing the environmental constraints on companies wishing to do so.

An even better alternative would be for government to support research on new materials that could substitute for critical metals. This is not to argue that federal funds should be devoted to developing expensive technologies that would be economical only if supplies were disrupted. Such a policy would impose not one but two unnecessary drains on the economy: the direct cost of the R&D, and the loss of other investment opportunities that might have led to more profitable technologies.

It does make financial sense to support R&D programs designed to develop new materials that provide more efficient and cost-effective products. Often such developments also provide the added benefit of reducing reliance on overseas suppliers. However, replacing critical materials should not be the primary purpose of such research.

The Tough New Ceramics

Materials researchers at a number of universities are now developing ceramics, plastics (polymers), and advanced composites that meet these two criteria. None requires critical minerals either as raw materials or in the manufacturing process.

Interest in advanced ceramics is keen because they can withstand higher temperatures and more hostile environments than today's metal alloys, superalloys, and plastics. This makes them ideal for automotive

DIAGRAMS: OMNIGRAPHICS

U.S. manufacturers are already using new composite materials in place of superalloys, which are made of critical metals, in making jets. Inset: Workers at Boeing fabricate an advanced composite by laying a honeycomb carbon matrix around several layers of woven graphite fibers. The result is an extremely smooth, stiff elevator panel for the new jetliner (right).

and gas-turbine engines, heat exchangers, automotive turbochargers, and burner nozzles. In addition, their hardness and resistance to corrosion make ceramics a promising substitute for metals in cutting tools, seals, bearings, and sandblasting nozzles. Indeed, advanced ceramics are the most likely candidates to replace our four most critical materials.

Ceramics are already cost-competitive with conventional materials in cutting tools, pump seals, and gas igniters. Ceramics are gaining commercial acceptance as cutting tools because they operate at high speeds, have excellent wear resistance, and produce smooth finishes. Since cutting tools now consume almost 40 percent of the tungsten and 20 percent of the cobalt used domestically, ceramics will be key in reducing our reliance on these materials. Overall, the use of ceramics to replace wear-resistant and heat-resistant steels and superalloys in cutting tools, seals, engine components, and magnets could reduce demand for cobalt by 10 percent and demand for tungsten by 20 percent.

Ceramic turbocharger rotors, cylinder liners, and other parts for automobile engines are close to commercialization. Such ceramic parts would replace those made of steel, specialty steels, and superalloys, eventually saving up to 10 percent of our chromium consumption. If a partially ceramic gas-turbine engine can be developed with emissions below Environmental Protection Agency standards, up to 50 percent of domestic platinum consumption could also be saved.

The Growing Market for Plastics

Direct substitutions of plastics for critical materials or metal alloys that contain them are rare. But plastics able to withstand continuous temperatures of 500° C have the stability required for use in rotor blades for gas-turbine engines.

The plastic automobile engine is even closer to commercial reality. One developer has already used a motor that is 60 percent plastic to power the winning entry in an endurance race in New York last year. The driver was able to record lap speed of 94.8 mph with the engine attaining speeds of 14,000 rpm. Most auto engines contain only small amounts of critical materials. However, eliminating their use in the 7 million car engines produced annually in the United States would greatly reduce our vulnerability.

Plastics will play an even larger role in reducing our dependence on critical materials through secondary effects. For example, substituting them for heavier steel sheet in autobodies will make possible the use of smaller, lighter engines and components.

Similar results could be achieved by developing composite materials. Composites are composed of a matrix substance that holds together stiff fibers. These fibers—usually carbon or glass filaments—are combined with the matrix, which is often an epoxy or polyester resin, to form a solid compound. Composites made of a carbon matrix and filaments are lightweight, show great stiffness and strength at high operating temperatures—perhaps as high as 1,350° to 1,925° C for long periods—and contain no critical materials. However, the composites developed so far tend to degrade at extremes of temperature, and it is doubtful that they will play a major role in the short run. Still, industry sources anticipate that with further advances, carbon-carbon composites could replace superalloys in jet engines by the end of this decade. A similar substitution may be possible in the turbine engines that power small cruise missiles.

Scientists are developing composites made of a ceramic matrix for a variety of space and military applications. They are tougher and more resistant to rapid temperature changes than conventional ceramics, and are therefore being considered for use in gas-turbine and jet-engine components, spacecraft heat protectors, and rocket nozzles. The composites will substitute for superalloys in all these cases. If successful, ceramic composites could replace up to half the superalloys made in the United States within 10 to 25 years.

The Reagan administration has said it wishes to support R&D on improved materials and technologies that would reduce our reliance on critical materials. Unfortunately, it has not substantially increased funds for university and industry research in this area. Overall, however, the administration's policy of relying on the workings of the free market to ensure the supply of critical materials for civilian use is wise. In this one area, at least, the market seems to be able to take care of itself.

JOEL P. CLARK, associate professor of materials systems at M.I.T., is director of the Materials Systems Laboratory. FRANK R. FIELD III completed his doctorate at M.I.T. in materials engineering in June and is continuing research in the Materials Systems Lab. THOMAS B. KING is a professor of metallurgy at M.I.T. JOHN V. BUSCH, BARBARA POGGIALI, and ELAINE P. ROTHMAN are graduate students in the Department of Materials Science and Engineering at M.I.T.

PHOTOS: BOEING

How Exxon uses computer our understanding at

At Exxon, theory and mathematics, coupled with the computer, are helping to revolutionize the research and development process. In fact, computer models are fast becoming a new probe for complex systems, coequal with experiment.

The Theoretical and Mathematical Sciences Laboratory: Dealing with complexity

New mathematics helped create the computer. Now the computer is creating an accelerating demand for new mathematics. In the process, linear mathematics is giving way to more complex, nonlinear mathematical ideas and models.

At the Theoretical and Mathematical Sciences Laboratory of Exxon Research and Engineering Company (ER&E), these developments are helping our theoretical scientists and mathematicians gain insight into such basic matters as metallic strength, corrosion and catalysis. Difficult problems are now being solved by combined use of the laboratory and computer modeling.

Catalytic Activity: A new understanding

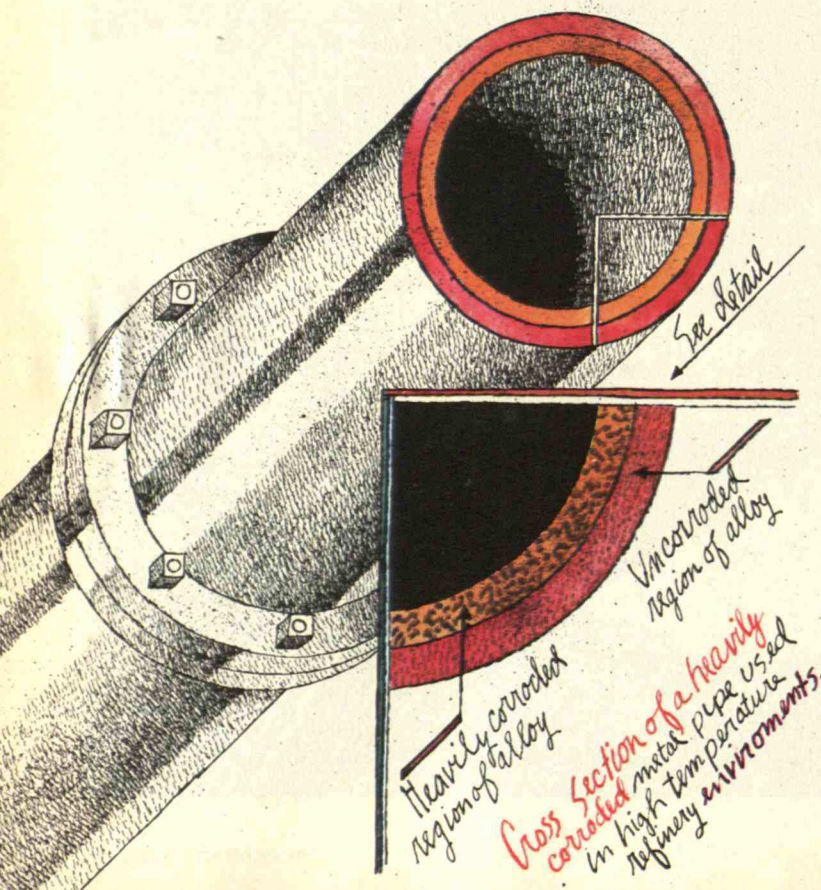
Catalysts based on transition metal sulfides have been widely used for sixty years in processing petroleum, particularly to remove sulfur and nitrogen. Increasing amounts of sulfur and nitrogen in today's feedstocks make these processes particularly important, yet the fundamentals of catalytic activity have been little understood. Now, by numerical solution of the equations of quantum chemistry, a quantitative correlation between catalytic activity and the electronic structure of the catalysts has been demonstrated for the first time.

Data from a model hydrodesulfurization reaction uncovered large differences in activity for various catalysts. Theoretical calculations revealed relationships between this behavior and the electronic structure of the catalysts. Information such as this opens the way to systematically controlling catalyst properties.

Alloy Oxidation Modeling: A new theory

In many industrial processes it is necessary to use complex metal alloys that can survive high-temperature, corrosive environments. These alloys can withstand such harsh environments because of their ability to form protective oxide coatings or scales.

Now a new nonlinear mathematical theory for alloy oxidation has been developed through a collaboration of Exxon metallurgists and mathematicians. Computer-generated solutions have advanced our understanding of how the



modeling to extend the molecular level.

physical processes interact in forming protective oxides. We now see opportunities for controlling an alloy's environment in order to promote these scales.

Computer Simulation of Grain Growth in Metals: A new solution

The physical and chemical properties of materials are determined in part by their microstructure. Grain orientation and size affect yield strength, fracture, surface adsorption phenomena and other properties. In order to effectively tailor the microstructure for specific applications, the understanding of the mechanism and kinetics of grain growth and recrystallizations would provide valuable guidance.

Exxon scientists have developed a method to bridge the gap between the atomistic interactions and macroscopic structure of materials. The microstructure is mapped onto a discrete lattice by dividing the material into small volume elements and placing the centers of these elements on lattice points. This discrete model preserves the topological features of real systems and can be studied by computer simulation using Monte Carlo techniques.

To test this method, the simulation was applied to a long-standing metallurgical problem–grain growth in isotropic polycrystalline metals. For the first time, all features of its microstructure (topology, morphology and kinetics) were correctly predicted. Now, similar modeling is being used to study the development of microstructure when stresses and temperature are applied. Our objective here is to design microstructure starting from atomistic interactions.

Exxon Research and Engineering Company

Exxon Research and Engineering Company is a wholly owned subsidiary of Exxon Corporation. More than 2,000 scientists and engineers are working at ER&E on petroleum products and processing, synthetic fuels, pioneering science and the engineering required to develop and apply new technology in the manufacture of fuels and other products. For more information, write Ed David, President, Exxon Research and Engineering Company, Room 102, P.O. Box 101, Florham Park, New Jersey 07932.

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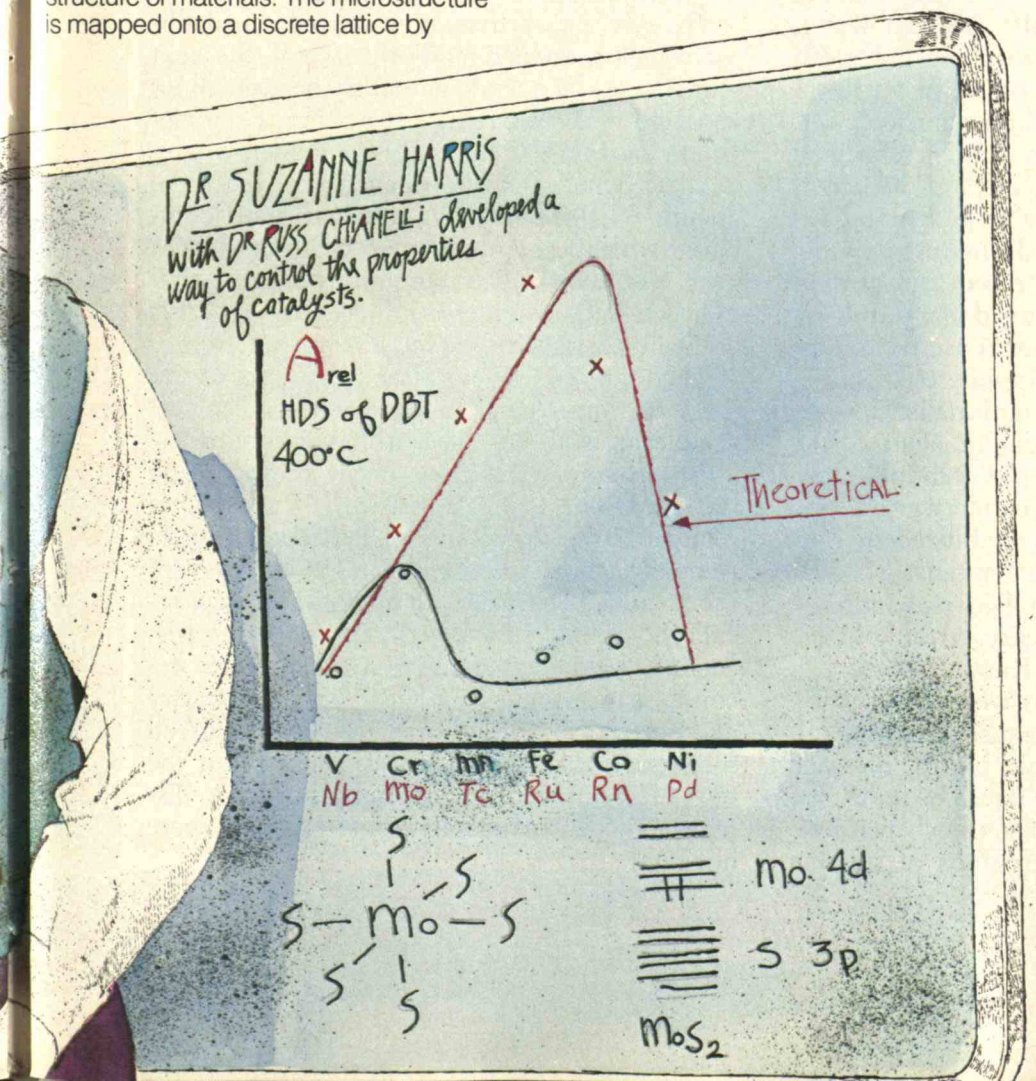
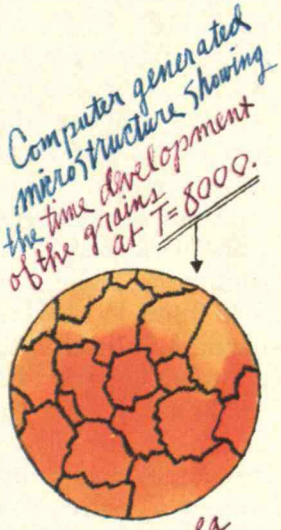
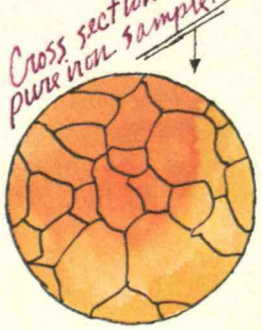






Crisis Management: Preventing Accidental War

BY HILLIARD RODERICK

By planning ahead, forging agreements, and installing new information technologies, the U.S. and the Soviet Union may avoid fatal mistakes that could lead to nuclear war.

"We all muddled into war," said Lloyd George, the British prime minister during the last half of World War I. But for a series of tragic errors, the European powers might never have joined in battle in August 1914. The overwhelming mistake was that none of the European leaders expected war. Yet they all imagined that if war did occur, whoever went on the offensive and mobilized first would win. Battles would be fast-moving, dependent on railroads for rapid transport of troops. And everyone would be home by Christmas. In part because of those flawed assumptions, small incidents rapidly escalated.

In June 1914 a Serbian nationalist assassinated Archduke Franz Ferdinand, heir to the Austro-Hungarian Empire. The archduke's uncle, Emperor Franz Josef, declared war on little Serbia. Reluctantly, Russia mobilized in support of its small ally in the Balkans. Misconstruing a peace offer from Russia, Germany joined its ally, Austria-Hungary. Afraid of Germany, England sided with Russia. At the last moment, when the Germans were about to invade Belgium, the kaiser changed his mind and telegraphed his troops to halt, but the message arrived a fatal half-hour too late. The industrial nations bled for four years of trench warfare; sometimes hundreds of thousands of soldiers were killed or wounded in an effort to move the front only a few miles.

Though one side has often started war deliberately, as happened in World War II, the next global war, if it occurs, will likely be accidental. It would make little sense for either the Soviet Union or the United States to launch a premeditated nuclear strike, or even a conventional assault. Neither side has much to gain compared with the unprecedented destruction that both would risk. It is far more probable that mistakes and misunderstandings during a crisis will lead to tragedy.

Too many crises have already brought us too close to that—the U.S.-Soviet tank faceoff at the Berlin wall in 1961, the two countries' jousts in support of their client states during the 1967 and 1973 Arab-Israeli Wars. Many remember the tense days of President John F. Kennedy's blockade of Cuba in 1962 to prevent the Soviets from installing missiles, but few recall the errors committed during that crisis. Against Kennedy's explicit wishes, a U.S. reconnaissance plane flew near Soviet territory and strayed over the border. Kennedy agreed to remove U.S. missiles from Turkey, but the bureaucracy failed to carry out his order to dismantle them. Fortunately, those mistakes were not fatal.

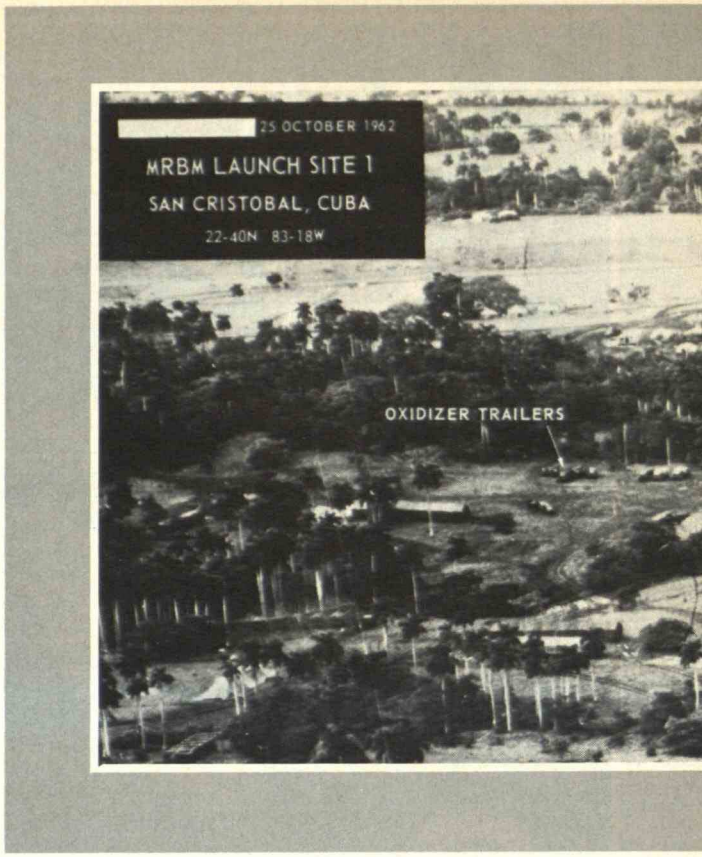
U.S. and Soviet tanks face off during the 1961 crisis at the Berlin wall.

Billions of dollars worth of information technology are set up to warn of a missile attack—sometimes providing false warnings—but comparable effort has not been devoted to help leaders handle a tense situation. "Think of the telecommunications-computer revolution that has occurred in this society," said the late Richard S. Beal, special assistant to the president for national security affairs until last fall. "When I arrived, the White House had a great big corner office utterly without technology. I found a pencil." The Washington-Moscow hotline—one technology that can help communications between the two countries—is being upgraded but will still consist of a standard facsimile system.

The failure of U.S. and Soviet officials to install better technologies to handle crises is emblematic of their fundamental failure to do enough planning about what is likely to happen—and go wrong—during crises. Some historians believe World War I was the inevitable outcome of decades of military buildup by the European powers. If the assassination of the archduke had not ignited war, some other mischief would have. But other historians are not so sure. Maybe the Great War did not have to be fought at all. Today, despite the U.S.-Soviet arms buildup, can the two countries negotiate agreements, set up new institutions, and install information technologies to prevent and mitigate errors during crises and thus avoid escalation?

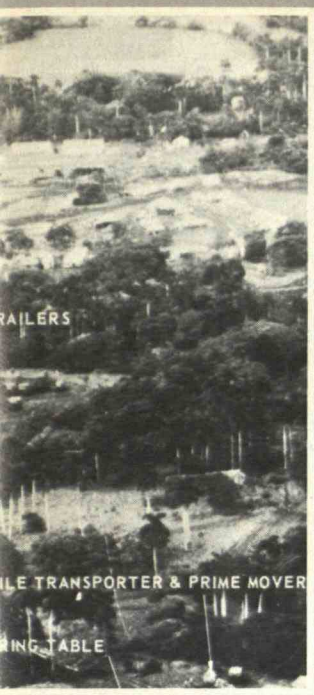
What Happens in a Crisis?

A crisis materializes only if leaders believe that opponents' actions will damage their nations' interests and possibly their own political power. During the 1956 Hungarian revolution and subsequent Soviet invasion, President Dwight D. Eisenhower concluded that U.S. interests were not threatened enough to warrant intervention, and he sent Premier Nikita Krushchev a note to that effect. What had seemed a possible crisis was soon forgotten. However, in the Cuban missile crisis, Kennedy saw that the installation of Soviet missiles in the Americas would bolster the Russians' first-strike capability and impair U.S. prestige. In discussions with his staff, he expressed fears that if he allowed deployment, he would lose power to the right wing. Such fears may have been realistic. Kennedy's successful stand in Cuba resulted, of course, in a political as well as a diplomatic victory.



As in the crises leading to World War I, leaders often see few alternatives to either capitulating or fighting, and they feel they must make decisions under intense time constraints. Today critical decisions may have to be made in a matter of minutes. During the first 48 hours of the Cuban missile crisis, the only alternatives offered to Kennedy were verbal denouncements and an air strike. Paul Nitze, then an assistant secretary of defense, recalls that when Secretary of State Dean Rusk learned that a Soviet missile site was being prepared at San Cristobal, he drew Nitze aside. "We both knew that the Pentagon had prepared contingency plans for an invasion [by the United States] or an air strike," Nitze said later. "Suddenly the contingency had become a fact. We both felt that either plan, in execution, would have grave and perhaps unpredictable consequences . . . We found it hard to imagine that the Russians would not respond by moving against Iran, or Berlin, even Vietnam." Fortunately, unlike the European leaders in 1914, Kennedy waited for the initial heat to subside and discovered a middle course between war and capitulation: the blockade.

Seeing few options and feeling intense time pressure, leaders foster the impression that they have iron will, and a deadly serious game of perception begins. Consider the confrontation between the superpowers in the 1973 Arab-Israeli War. After crossing into the Sinai, Israel surrounded the critical Third Army of Egypt and threatened to destroy it—and thus deal



Taken on October 25, 1962, this reconnaissance photograph shows Soviet preparations for installing nuclear missiles in Cuba.

Mistakes during the ensuing crisis could easily have led to war. At first, Kennedy's advisors offered him only two options: lame denunciations and invasion. Fortunately, he waited and settled on a middle course: the blockade. Against Kennedy's orders a U.S. spy plane strayed near the Soviet Union. Fortunately, the Russians did not take it for a bomber.

Kennedy later estimated that the odds of war had been "somewhere between one out of three and even."

a major blow to Egypt's ally, Moscow. The Russians told Washington that unless it agreed to help stop the war, they would do so alone by sending in paratroopers. Several airborne divisions of Soviet troops disappeared from southeast Russia.

In response, at around midnight on October 25, President Richard M. Nixon ordered U.S. forces to go to a higher state of nuclear alert. Such an alert was visible to the Russians, as Nixon intended. Nuclear silos opened up, Strategic Air Command bombers in Guam flew to the West Coast, communications frequencies—as well as the information exchanged by military forces—changed.

By 2:00 A.M. the Russians could see the effects of the alert on U.S. forces around the world. Soviet Ambassador Anatoly Dobrynin began calling Secretary of State Henry Kissinger, but Kissinger did not answer. At 5:00 A.M. he sent his aide Lt. Gen. Brent Scowcroft to Dobrynin with a handwritten message, telling him that Washington would not allow the Russians to go any further in entering the war, nor did the United States intend to do so. Though there is no hard evidence for it, Kissinger must also have pressured Israel to halt its troops. By early afternoon, the Israelis had said they would not destroy the Third Army, and the Russians had agreed not to enter Egypt.

Even though this incident was settled in a way that was satisfactory to both sides, there is a deadly element in such a game of perceptions. The very same action that one side must take to prove that it means business—a nuclear alert or a movement of troops—is indistinguishable from preparation for an attack and may be interpreted as such by the other side.

How Both Sides Handle a Crisis

In a crisis, each leader sits atop a bureaucracy of millions of civilian and military personnel. The leader can make only a few major decisions based on advice that filters up through the bureaucracy, and the bureaucracy must then implement countless details. Thus, in the crisis during the 1973 Arab-Israeli War, Nixon made one major decision: to order the armed forces to go to nuclear alert. In the Cuban missile crisis Kennedy had the choice of a denouncement, an invasion, or a blockade. Having chosen the blockade, he was able to decide how large a circle to make (after his original decision, he reduced the size of the circle to give the Russians more time to comply). He was also able to decide whether to let any ships pass (he allowed one tanker through unboarded but stopped the second).

As Richard Beal has pointed out, the president gives orders to the bureaucracy but may not know for hours or days if they are carried out, modified, or ignored. In the Cuban missile crisis, not only were Kennedy's orders to remove U.S. missiles in Turkey and to cease all flights near Soviet borders ignored; another order may have been misinterpreted. He told the navy to bring the Soviet submarines to the surface, but it is still debated as to whether he knew the navy would use depth charges to do so. The depth charges did bring the submarines up—but they might have fought back instead.

A presidential decision is implemented through numerous standing orders that tell officers what to do under given circumstances. These standing orders change depending on the level of military alert, and the way they change could itself impair the president's ability to enforce a decision during a crisis. In peacetime the standing orders are restrictive, and officers are allowed to do little without permission from superiors. However, the higher the level of the alert, the more decision-making authority is transferred to local commanders, on the theory that they can best judge their situation. At a high level of alert, a commander could well do something that the president did not intend.

The highly centralized and bureaucratic Soviet re-

PHOTO: U.S. AIR FORCE

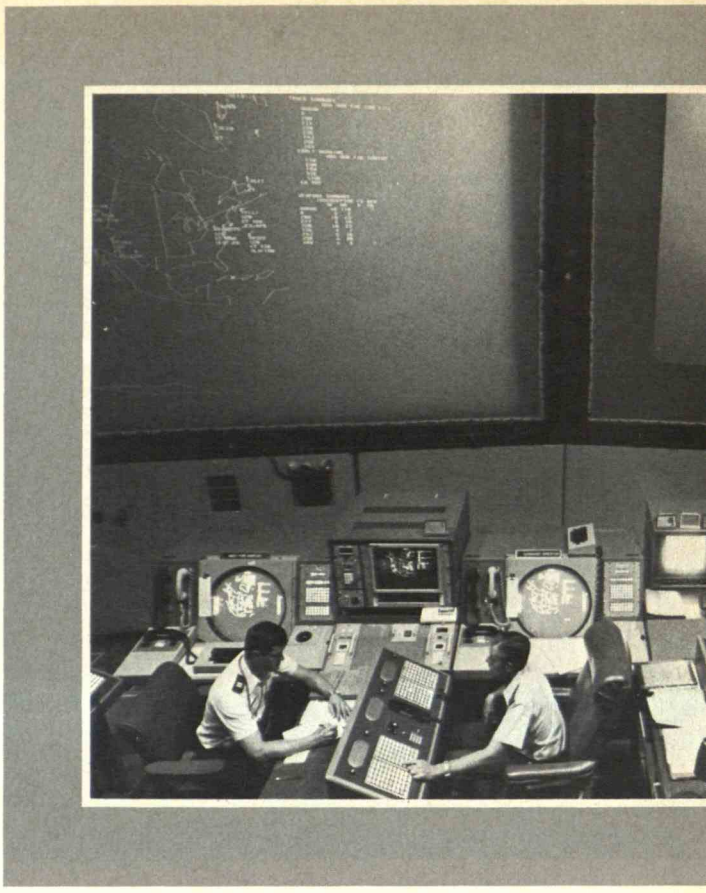
gime appears to operate differently. In the September 1984 issue of *Survival*, Douglas Hart, a defense analyst at Pacific-Sierra Research Corp. in Arlington, Va., argues that owing to its concern over uncertainty in a crisis, Moscow allows its local commanders less discretion than the United States does. The Soviets seek control over both events and their own military forces, especially those armed with nuclear weapons. As if making a move in chess, they will take a calculated risk and wait to see how the United States responds.

Thus, on August 13, 1961, the Russians erected a temporary barricade of barbed wire and other obstacles at various crossing points between East and West Berlin. If Moscow deemed it necessary, the fence could easily come down. The United States voiced protests, and on October 27, U.S. and Soviet tanks faced each other at Checkpoint Charlie. However, neither side moved forward, and the next morning the tanks just dispersed. Having concluded that the United States would not start a war over the Berlin wall, Moscow erected permanent barriers.

But despite their concern for maintaining control over events, the Soviets could contribute to escalating a crisis. Consider the 1973 incident when they threatened to land troops in Egypt. The Soviets presumably calculated that these troops could be reinforced or removed, depending on U.S. reactions. However, when the United States went to a higher nuclear alert, no one could have foreseen the consequences. The Soviets might also have gone to a higher nuclear alert, and the risk of accidental nuclear war would then have been considerable.

Errors During Crises

Several types of errors occur during crises. The civilian or military bureaucracy that is supposed to carry out the leader's plans may make the wrong moves. Sometimes the problem stems from the nature of bureaucracy, as in the U.S. failure to remove the missiles from Turkey during the Cuban missile crisis. Sometimes the failure to communicate is technical, as in an episode that occurred during the 1967 Arab-Israeli War. The Pentagon sent six urgent messages to the *Liberty*, a U.S. electronic-surveillance vessel that was in the war zone, to "flee for your life." However, the messages were misdirected, with some going to the Pacific Command rather than the Mediterranean. Apparently mistaking the *Liberty*



for an enemy ship, Israeli planes machine-gunned it; 24 sailors died and 171 were wounded.

The very nature of crises seems to increase the chance that military mistakes will occur, as numerous U.S. rescue efforts attest. Such missions are carried out by well-trained troops, but in tense situations Murphy's law applies, and if anything can go wrong, it will. For example, in the unsuccessful attempt to rescue the U.S. prisoners held in Iran in 1980, helicopters crashed because of a sand storm for which no one had prepared, and that was far from the only snafu. The military decided not to fly a C-5 communications plane for fear it would show up on radar, and as a result communications were poor. The helicopters landed in disarray at the rendezvous spot, with the commander, for example, arriving much later than other soldiers. Furthermore, the location turned out to be near a road along which a bus traveled: hardly ideal for secrecy.

Even in peacetime the superpowers' militaries commit errors by becoming involved in clashes that the leaders do not intend—and in fact may not even learn about until afterward. U.S. and Soviet ships and submarines have sometimes played chicken: two ships approach each other on a collision course and wait for the other to veer off. Sometimes neither does and a crash occurs, such as the one between the U.S. aircraft carrier *Kitty Hawk* and a Soviet submarine in the Sea of Japan in 1984. U.S. and Soviet ships have aimed guns at each other during tense situa-

The North American Air Defense Command (NORAD) post inside Colorado's Cheyenne Mt. uses sophisticated technology to detect Soviet missiles if they are launched. However, such technology is far from flawless. In 1980 the military went on two nuclear alerts because of false warnings.

If a nuclear alert had already been called during a crisis—as it was in the 1973 Arab-Israeli War—a false warning would be especially grave. Normal steps in the command chain can be bypassed during such an alert to keep U.S. forces from being caught in a surprise attack.

tions. Soviet planes have even practiced dive-bombing U.S. vessels for many days. Obviously, such clashes would be especially grave during crises. If either U.S. or Soviet fatalities occurred, an understanding that the two nations' troops will not kill each other would be broken.

Perhaps the worst danger surrounding mistakes committed by one nation's military is that the other side can misinterpret them. The leader of the nation at fault is not likely to know about the mistake, but the opponent will assume that it was deliberate. During a crisis, if one nation's missiles are not removed in accordance with an agreement, if a ship does not leave a war zone as ordered, if a submarine strikes an aircraft carrier on its commanding officer's initiative—the opponent's military could view these actions as belligerent and proceed accordingly.

Errors in assessing what the opponent is doing can be even more serious than the military's errors of commission. Failures in sensing devices, for example, occur fairly frequently even in peacetime. False targets (a flock of birds, the moon) and faulty signals in electronic equipment have resulted in erroneous warnings that missiles have been launched. Indeed, in 1979 some 1,500 false missile warnings occurred in the North American Air Defense Command (NORAD) and other commands. Fortunately, information from other sensors rapidly provides evidence of a false alarm. If a radar or satellite picks up an indication of a missile, other radars or satellites are directed to follow its apparent flight path, and the warning is assumed to be false unless these sensors agree with the first.

But the evidence of a false warning does not always come as quickly as one would hope. Because of a chip failure on June 3, 1980, the military went on nuclear alert for three minutes. Strategic Air Command crews were ordered to start the engines of B52 bombers, and land-based missiles were brought to a higher state of readiness. Senior military personnel had to call a threat-assessment conference, in which they talked over the telephone and cross-checked information from independent sensing systems, to decide that no attack was under way.

In a crisis, especially a nuclear alert, U.S. forces respond more immediately to a warning than in peacetime. The exact protocols are classified, but it is probable that weapons would not fire automatically; information from sensing systems would be provided to a top military officer, who would give the order. Still, as the level of alert increases, nuclear forces become tightly coupled to warning systems: many ordinary steps in the command chain can clearly be bypassed to keep U.S. forces from being caught in a surprise attack. As Paul Bracken, a professor of political science at Yale, writes in *The Command and Control of Nuclear Forces*, "At the highest levels of alert (which have never come close to taking place) the coupling might become so tight, and the checks and balances so removed, that the stability of the command system itself would be in doubt"—the system would be on a hair trigger.

In addition, all sensors would be switched to their warning functions, pouring a deluge of information into military headquarters and making decisions more difficult than ever. False alarms or blackouts of sensors could add to commanders' fears: would they judge that the sensors were malfunctioning or that the nation was under attack?

Of course, Soviet warning and nuclear systems also become unstable during a crisis, and the two countries' systems begin to interact dangerously. If the United States opens its silos, Moscow may respond by opening its own, prompting U.S. forces to take further measures and creating a ratchet effect.

Misjudgments by leaders on both sides may be the gravest of all mistakes that can occur in a crisis—and the hardest to prevent. In 1914 Kaiser Wilhelm II of Germany thought that the affair between Austria-Hungary and Serbia could somehow be me-

PHOTO: U.S. AIR FORCE

A number of mistakes could occur during a crisis and lead to escalation unless both sides worked together rapidly. The U.S. and the Soviet Union might have only days, hours, or minutes to resolve misunderstandings.

MISTAKE	EXPLANATION	TIME TO LIMIT CONSEQUENCES
One side initiates military clash	Unauthorized action owing to breakdown of procedures; accident such as weapon firing owing to equipment failure	hours or days
One side experiences satellite blackout	Failure of equipment; unauthorized satellite attack by other side	minutes or hours
Nuclear weapon fired by one side	Unauthorized launch owing to breakdown of procedures; failure of equipment	minutes or hours
One side wrongly believes other is preparing for nuclear or conventional attack	Misinterpretation of military move intended to improve security or coerce opponent	hours or days
One side wrongly believes other explodes a weapon	Explosion by third nation or terrorist group misinterpreted	hours or days
One side wrongly believes other has launched missiles	False sensor readings; ambiguous sensor readings misinterpreted	minutes or hours

diated, but instead of trying to do so he walked around with the idea in his head for three days, until it was too late. Early in the Cuban missile crisis, Kennedy could easily have made a fateful error by choosing one of the obvious alternatives of capitulation or invasion.

Preventing Errors of Commission

The United States and the Soviet Union can take steps to prevent their military and civilian bureaucracies from committing some of these errors. Command, control, and communications (C^3) systems could be improved to ensure that messages get through, as they did not to the *Liberty*. Better technology could also enable different branches of the armed services to talk to one another, as they failed to during the Grenada invasion. U.S. soldiers on the island were unable to radio navy pilots directly above them.

Communicating with nuclear submarines is difficult, and the president may not even have direct control over them. New technologies such as the use of blue-green lasers could provide this communication. However, some independence for submarines may actually aid deterrence, as sub commanders are instructed to retaliate even if the president and the leaders who succeed him are killed. Thus, the United States may decide not to improve some communications technology even at the risk of impairing the ability to manage a crisis.

In fiscal year 1985 Congress appropriated $18.5 billion to improve C^3, and the military has requested $22 billion for 1986. However, most of this money is not being used to improve the tactical C^3 of the military forces, useful in crises, but is intended to harden communications lines to strategic weapons so they will function after nuclear blasts begin.

Clashes between vessels have already been drastically reduced by the 1972 U.S.-Soviet Agreement on the Prevention of Incidents at Sea. Some 40 clashes occurred in 1983, only one-third as many as before the treaty went into effect. Among other things, the agreement requires ships to keep a certain distance apart and prohibits them from pointing guns at each other and making mock bombing runs.

Incidents similar to those at sea may also occur in the air, on land, and even in space. About a year ago, a U.S. helicopter was shot down over Czechoslovakian airspace; the fate of Korean Air Lines flight 007 is well known. A land clash could occur in Pakistan, for example, where the United States is supplying rebels fighting the Russian-backed regime in Afghanistan. If the Soviets should raid Pakistan to wipe out the rebels, Americans might feel obligated to support their allies and hence come to blows with the Russians.

Rules of the road similar to the agreement on preventing incidents at sea should be negotiated to handle accidents and clashes on land, in the air, and in

Some 600 intelligence reports pour in daily from Iran and Iraq. What should the president be told?

space. As at sea, such rules could help prevent a crisis. If one side clearly broke the rules, then the other side could justifiably assume its opponent had belligerent intentions.

Similar rules could even help the two nations disengage from unintended brushes such as one that occurred during the 1973 Arab-Israeli War. The United States moved its aircraft carriers from the Western Mediterranean toward Israel. A Russian fleet followed, in accordance with Soviet naval strategy of tracking U.S. fleets with enough ships to ensure an even match should fighting break out. As each fleet sought to protect its ally in the war and perhaps to threaten its opponent's, the two sides drew close to each other. Eventually, they stood 500 yards apart, ready to shoot.

Suppose a few salvos were exchanged in such a situation even though neither side wanted a battle. Rules could provide a way for commanders to disengage. A prearranged signal—a high-technology analogue of the white flag—could indicate the desire for a ceasefire. If one side communicated the signal and the other side replied similarly, the ceasefire would be in effect. Of course, if one side broke it, the other would assume belligerent intentions and proceed accordingly. But if the ceasefire held, protocols could guide further disengagement.

Correcting Perceptions

The U.S. intelligence community uses a wide variety of sensors to detect Soviet activities during a crisis, as does the Russian intelligence community to detect American actions. Optical sensors on U.S. reconnaissance satellites are said to have a resolution of less than 10 centimeters, enabling them to recognize individual tanks. Listening devices on satellites can likely intercept radio communications throughout the Soviet Union, and even eavesdrop on many telephone conversations carried over ordinary wires. Not only specific conversations but also deviations in communications traffic can provide warning of troop mobilization. Infrared sensors on satellites can detect the heat produced by the engines of large numbers of tanks and trucks, thereby warning of unusual movements of vehicles during preparations for war. The United States now has some 60 surveillance satellites aloft and is planning to launch more. The NAVSTAR system alone will contain 18 satellites in geosynchronous orbit (at fixed positions above the earth). This system is intended, among other things, to monitor nuclear explosions.

However, all these sensors can make errors, and even when the information they supply is correct it means little until interpreted by the intelligence community. The first job of intelligence officers is simply to correlate different sources of information to make reasonably sure that their picture of physical events is accurate. The more difficult job is to decipher the meaning of the opponent's behavior.

The hotline is intended to help with that task. Today the system takes six or seven minutes to transmit a page of text, but by agreement it is being upgraded to facsimile transmitters that can send a page a minute. The transmitters can also send contour maps, which may be essential in a crisis. The system could be upgraded further to send a page in a few seconds, allowing more time for deliberation, and to be mobile so that the president could use it while away from the White House. However, the Soviets have not agreed to the latter improvements.

Setting up crisis-control centers in Washington and Moscow would be a more comprehensive way to improve communications and reduce the likelihood that either country will misjudge its opponent's intentions. Each center would be staffed by senior military and diplomatic officials from both nations—say eight U.S. and four Soviet officers in Washington and the reverse in Moscow. The centers would be linked by telephone, video, and computer. In the capital city where it is located, each center would be able to communicate with the head of state, foreign service, and military command.

In *Beyond the Hotline*, William Ury of the Harvard Negotiation Project discusses how to set up crisis-control centers. In fact, several proposals to do so have been put before Congress, first by the late Sen. Henry C. Jackson (D-Wash.) and most recently by Sen. Sam Nunn (D-Ga.) and Sen. John Warner (R-Va.). About a year ago the Senate approved a nonbinding resolution calling on the president to pursue this idea. So far Reagan has not done so, though while in Europe this spring he did call for setting up a direct hotline between U.S. and Soviet military headquarters. In the immediate political climate the prospects for establishing full crisis-control centers are poor, but that could well change in coming years.

The main function of the centers would be to help each side better understand the other's actions and

intentions. Consider a typical misunderstanding. When Israel machine-gunned the *Liberty* in 1967, Defense Secretary Robert S. McNamara thought the Soviet Union was responsible. Fortunately, President Lyndon B. Johnson did not retaliate, but rather ordered an investigation and sent a message over the hotline informing Moscow that he was doing so. When he discovered the Israelis' error, Johnson sent their apology to the Soviets over the hotline. That incident was handled without a crisis-control center.

But suppose terrorists detonated a nuclear bomb in an American or Russian city during a crisis: would the opposite side be so restrained? U.S. and Soviet officers, trained to work together at the centers, could assess reconnaissance photographs, computer printouts, and other intelligence data from both countries. Had any satellites spotted a missile? What submarines were in range of the bombed city? Each side could challenge possible misinterpretations.

During peacetime the personnel in the centers could devise strategies to reduce dangers—they might help both sides agree on how to prevent U.S. and Soviet fleets in the Mediterranean from engaging in a battle during a Middle Eastern crisis, for example. Symbols of superpower cooperation, the centers could be valuable in allaying anxiety and giving leaders time to deliberate.

Such centers would also have liabilities. They would provide a new mechanism for spying, and the officers in the center could lie about their leaders' intentions (if they even knew what they were). Also, leaders might simply ignore the centers at critical moments. However, lies can be transmitted over any medium, and the crisis centers could be an improvement on the hotline. As Ury puts it in his book, "If you had to work out a complex, high-stakes deal with a company on the other side of the country in an extremely short time, would you try to do it by sending telegrams back and forth?"

Better Judgments

Improved intelligence, the upgraded hotline, and crisis-control centers all are intended to help leaders make better decisions. To avoid panic reactions by leaders on both sides and allow them time to make better judgments, I have proposed that the United States and the Soviet Union work out an agreement whereby they could initiate a pause—or slowdown in military movements—during a crisis. Either side could indicate that it wanted a pause by contacting the other on the hotline, and of course there would be none unless both agreed.

A pause would not have to apply to all military activities but just those most likely to cause escalation. For example, if the United States sent aircraft carriers toward the North Cape of Norway, the Soviet Union, which normally keeps 50 percent of its submarines in the nearby harbor at Murmansk, would send them all to sea. Then, since the submarines carry nuclear missiles, U.S. forces would go to a higher state of alert, and the process of escalation would be under way. To prevent that, during a pause U.S. aircraft carriers would be barred from moving toward the seas off northern Norway and half of all Soviet submarines would have to remain in Murmansk. Minor actions could continue even while leaders conferred. If one side seriously violated the pause agreement—as indicated by technologies such as reconnaissance satellites—that nation would provide instant evidence of its aggressive intentions, and the opponent could resume its military actions.

Leaders will also be able to make better decisions if the system for providing information to them—not only during a crisis but before one erupts—is improved. Consider the Iran-Iraq War, a likely vehicle for superpower conflict. Some 600 intelligence reports pour in daily on the political, economic, and military aspects of events in the area. What should the president be told? As Richard Beal once ex-

Giving the president good information—such as during this consultation about the Lebanese crisis—is extremely difficult. Richard Beal, former special assistant for national security, said that after one Lebanon briefing President Reagan declared, "This is ridiculous. I not only don't know what they are talking about, I don't know where they're talking about it, and I don't have anything that helps me give context to it." Beal set up a "crisis-management" room, where interactive video can instantly furnish information from intelligence reports, background papers, and other sources.

plained, part of his job was to crystalize such information: "I have to process, to synthesize, megabytes of data in very short periods of time, to give descriptive clarity to what's going on."

After being briefed during the Lebanon War about U.S. "rules of engagement" and the locations of Druze militia, according to Beal, Reagan turned to an advisor and said, "This is ridiculous. I not only don't know what they are talking about, I don't know where they're talking about it, and I don't have anything in front of me that helps me understand or give context to it." At a conference held at Harvard in 1984, Beal insisted that such confusion is typical of decision making at the highest levels of government; human beings make tools to farm the land but not to help presidents make decisions.

In an attempt to improve leaders' ability to synthesize information, Beal created a "crisis-control room" in the White House. During a crisis, the president, secretary of state, and other high-level decision makers can go to that room and sit in front of a video console connected to a computer system. The system provides the same sort of information found in position papers and intelligence reports, but in a more accessible format, including images, charts, and text. The computer system can answer questions and thus is like a book tailored to describe what the decision maker needs to know. Of course, the system is as fallible as any intelligence report. Beal's aim in developing the crisis-management room was not to tell the president what to do but to facilitate the decision-making process.

According to Beal, U.S. monitoring of the Soviet shootdown of Korean Air Lines (KAL) flight 007 was handled entirely through information technologies, including the crisis-control room. "Everything that was known about the shootdown," he said, "everything that was written, everything that gave confidence to high-level decision makers was determined by the technology." He said that the administration quickly learned the precise details and timing of the actions and communications that occurred during the encounter. The United States obtained these facts from its own intelligence and checked them against Japanese reports.

However, flawless information technology does not necessarily produce flawless handling of a situation. While it is still unclear what, if anything, the U.S. government knew about KAL-007 before it was downed, Beal believed that through superior technology, Washington knew more than the Soviets did immediately afterward. At first, the Russians may have been unsure what had happened. But rather than discussing its information with them, the United States moved as fast as possible to denounce them, boxing them into a corner as they first denied the shootdown and then began to justify it. "That is a response we didn't really need to evoke," said Beal. "If our larger concern were not to beat the Soviets bloody over an issue but to foster U.S.-Soviet relations, we could take all the measured response we really need. Moving too rapidly is probably the single most significant error we make."

Unfortunately, errors are easy to make in a crisis, and even the best tools will not necessarily avert them. Misjudgments about the other side's intentions could be reduced if each country gained a better appreciation of the human aspects of its opponent's military-political system, and of the leaders' likely reactions to a crisis. Steps that increase communication between Soviet and U.S. leaders, and build toward at least a minimum of mutual trust, are especially important in planning to prevent war by mistake.

HILLIARD RODERICK, professor of world peace at the LBJ School of Public Affairs at the University of Texas at Austin in 1982-83; edited Avoiding Inadvertent War: Crisis Management *(LBJ School Press, 1983). Trained as a physicist, he has held senior posts with the U.S. government, UNESCO, and the Organization for Economic Cooperation and Development. At the OECD he successfully negotiated numerous international agreements.*

PHOTO: BILL FITZ-PATRICK, WHITE HOUSE

Continued from page 24

and shows at times when people are looking for something to do outside.

Of course, many downtown organizations do sponsor special events—parades, street fairs, sidewalk sales, ethnic festivals. But these are often held just for their own value rather than to achieve specific objectives. Programming of activities can become a management tool to bring people to places that are otherwise underused, attract people who might not ordinarily come downtown at certain times, or simply provide surprises for people on routine shopping trips. Ideally, a diverse selection of events should be choreographed throughout the year: an extravaganza or two using every available public space, regularly scheduled programs in parks and plazas, and daily street entertainers and performers. In northern cities the warm months are perhaps best for scheduling outside activities, but other seasons hold their own special promise. Dayton's Holiday Festival begins in late November and continues through Christmas, attracting thousands of people downtown for tree-lighting ceremonies, parades, and music.

The Greater Cleveland Growth Association's "Party in the Park" is one of the oldest and best examples of a regular schedule of well-planned events. The parties are held every Friday during the summer from 5 P.M. to 8 P.M., each in a different section of downtown. Their purpose is to keep people downtown after working hours and introduce them to parts of the city—as well as to businesses—they wouldn't normally see. The parties draw about 12,000 people to listen to live music, socalize, and drink beer. Each week a different nonprofit group taps the kegs and sells beer tickets, keeping the income.

Street vending can also contribute enormously to the vitality and prosperity of downtown. Yet in many cities attempts have been made to restrict or ban "peddlers." Merchants often complain that vendors draw customers away, or even scare them away, from their stores. City officials express concern about the sale of illicit goods, sidewalk congestion, and liability issues. However, experience in several cities, such as Chicago, Boston, and New Orleans, shows that vendors can actually provide a range of benefits for merchants, shoppers, and the city itself—if the vending is controlled.

One of the primary benefits of vending is that it draws people. The personality of the vendors, the uniqueness of their carts and wares, and the activity generated can all help create a distinctive character and lively ambiance downtown. Experience shows that rather than drawing business away from nearby stores, vending has a positive impact on downtown businesses, partly because downtown shops often do not carry the items vendors sell. Vendors can also help maintain the area around their carts, give directions or information, and provide a security presence on the street. Moreover, vendors provide revenue to a city that can be earmarked for other downtown programs.

Instead of trying to eliminate vending, then, downtown organizations can encourage city officials to develop appropriate regulations. Several of the most successful vending programs limit sellers to specific blocks of the downtown area and assign them fixed locations, with merchants participating in the siting process. Allocating vending sites usually turns out to be less problematic than many people expect. The vendors themselves understand the difficulties posed by too many carts in one space, and often welcome the formalization of what are usually ad hoc siting agreements. Regulations should also cover the goods that venders can sell to minimize competition with adjacent merchants. The types of goods that cities have found to be the most acceptable to merchants, vendors, and shoppers include flowers, fresh fruits and vegetables, crafts, sundries, and foodstuffs.

Some cities include a few other types of regulations in their vending ordinances. They often regulate the size and design of carts to minimize potential for sidewalk congestion. Food vendors are generally required to have trash-disposal bags attached to their carts, and to make arrangements for disposing of this trash at the end of the day. Grand Junction, Colo., even requires that vendors clean up the area within 25 feet of their cart. Most cities also limit vending to daylight hours. However, we feel this "safe period" could be expanded to include off-peak times, such as nights when stores stay open.

Too many regulations may be just as bad as too few, however. Over-regulation discourages the wide variety of goods that can add unique color and character to a downtown. Indeed, downtown organizations would do well to actively seek people who will design imaginative pushcarts and sell diverse products. Such encouragement sometimes yields rewards that go beyond the moment: the opportunity to operate vending carts has helped propel a growing number of entrepreneurs into retail businesses of their own.

Coordinating Management and Design

Management of public space works best when the design of buildings and the spaces themselves takes into account their impact on people. Although it's obvious that major new buildings permanently alter a city's skyline, it may not be as obvious that they have similar impact at street level. However, it is at street level that buildings must come to terms with their surroundings. Unfortunately, most new developments do not realize the full potential of their public spaces (*see "Small Space Is Beautiful" by William H. Whyte, July 1982, page 36*). Plazas, for example, often become nothing but windswept expanses of concrete. New buildings with blank walls or parking garages at ground level, rather than shops that open onto the street, may reduce the business of nearby stores. Our research shows that people walk faster past such locations: sidewalks become thoroughfares rather than places to stroll, socialize, and window shop.

Downtown organizations can help prevent such urban disasters by reviewing the designs of proposed new developments and large-scale renovation projects. The review process should consider how to integrate new developments into the functional fabric of the city. Design reviews seek to avoid problems *before* construction begins and help developers understand the potential of a site and how it relates to the rest of the downtown.

In cities that have official design-review boards, someone from the downtown organization may be able to become a member. In cities without official boards,

New highrises affect city streets just as much as they affect the skyline.

downtown organizations can form voluntary programs. City governments, of course, maintain the legal responsibility for controlling development, primarily through zoning. However, many downtown organizations have commissioned planning studies to identify the kinds of development that are desirable or needed. Information from such studies is often incorporated into a city's zoning ordinances or master plans.

For example, Denver's downtown organization, the Denver Partnership, studied plans for the city's new Sixteenth Street Mall, working with property owners, developers, merchants, and advocates of historic preservation. The result was an "incentive" zoning system that the city council approved unanimously. Under this system a developer could receive, say, six extra square feet of office space for every square foot of pedestrian-oriented retail space built.

This approach, in which downtown organizations work closely with developers from the earliest planning stages, has many advantages. Developers can save time, and therefore money, in gaining official approval for their plans. Downtown organizations have the opportunity to suggest, based on what they've learned from experience as well as studies, specific design features that would help integrate the development into the community. The success of this cooperative process ultimately depends on the persuasiveness of the downtown organization, the receptivity of the developer and the architect, and the amount of political pressure that can be brought to bear on the situation.

If voluntary design reviews are begun too late in the planning process or carried out with obstruction rather than cooperation in mind, the process will falter. The city will be the loser. But as downtowns enter a new period of growth, their private-sector organizations should also realize that they are no longer in a beggar's position where they must accept *any* kind of development. They can help shape the form and future of the city's most vital resource—its vibrant, active downtown.

STEPHEN DAVIES is project director of Project for Public Spaces, Inc., a New York-based organization that develops improvement plans for downtowns in the United States and Canada. This article is adapted from "Managing Downtown Public Spaces," a handbook prepared by Project for Public Spaces and published by the American Planning Association.

A new look at

Summary:

GTE lighting research operates on many fronts: a space lighting lab to study the motion of gases in a gravity-free environment; the use of various isotopes to enhance the output of fluorescent lamps; the production of light directly from excited molecules.

The science of lights and lighting might seem to be rather mature. Indeed, the standard light bulb has changed very little in at least half a century.

But lighting science is on the brink of revolution. Recent work by GTE points the way to major improvements in every type of lighting.

Lighting research in space.

One of the most powerful and efficient light sources is the high-intensity-discharge (HID) lamp. Its light is derived from gases and ionized vapors which are excited in an electrical arc contained in a quartz arc tube.

The gases circulate by gravity-induced convection, which mixes the radiating species in the arc. This tends to obscure other vital processes such as diffusion, cataphoresis (motion of ions toward the negative electrode), magnetostriction and vapor condensation. Researchers have wanted to observe these processes at leisure, in the absence of convection, for many years.

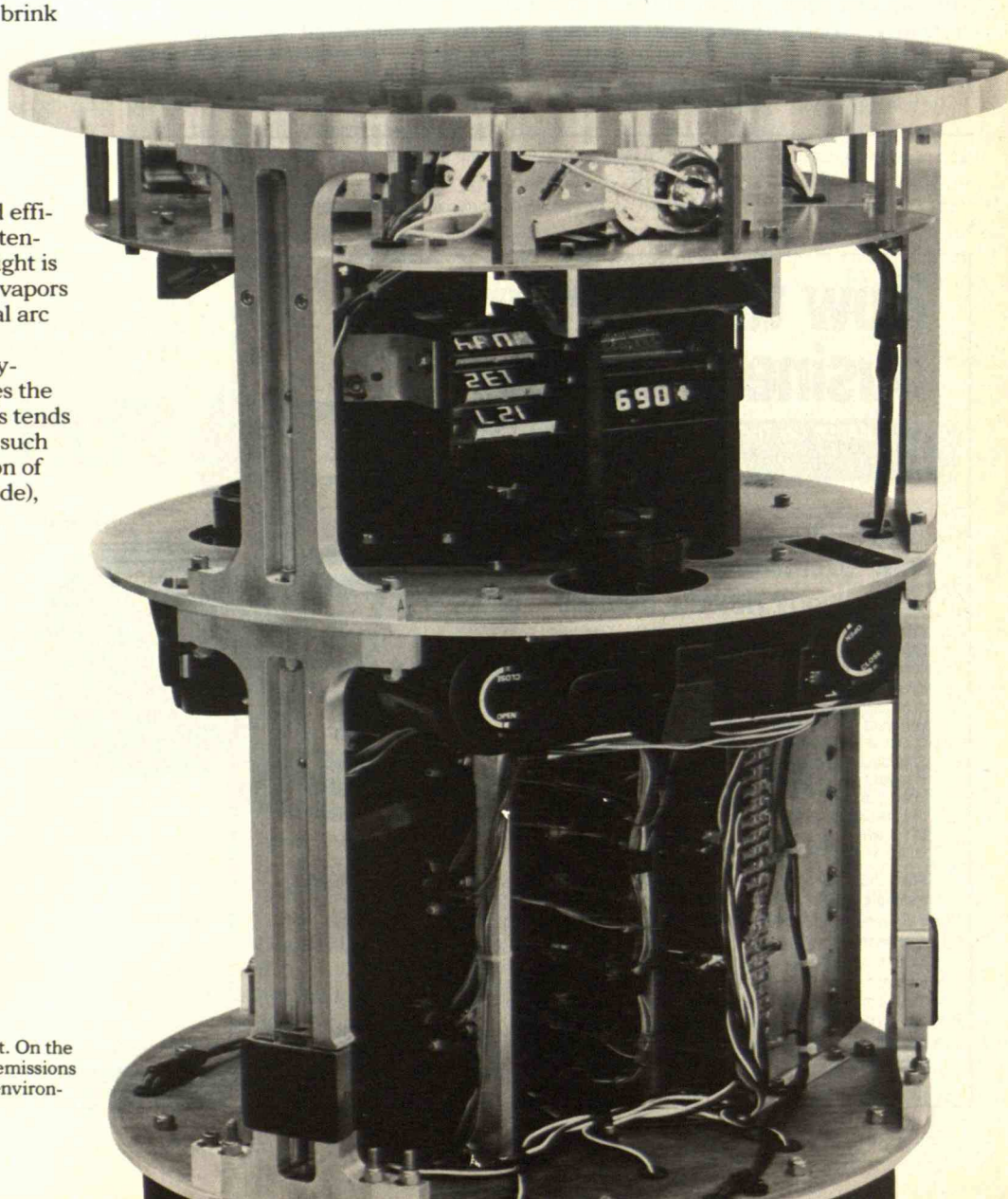
GTE has achieved this goal in a first-of-a-kind experiment aboard the space shuttle. A payload of three metal-halide HID lamps was operated in the microgravity environment of the orbiter. Each lamp was lit for half-hour periods while detailed spectroscopic, light output and electrical measurements were taken.

The results have substantially strengthened the technological underpinning drawn upon for lamp design. GTE scientists now have critical information and new insights that will produce lamps with brighter, whiter light.

Untrapping excited atoms.

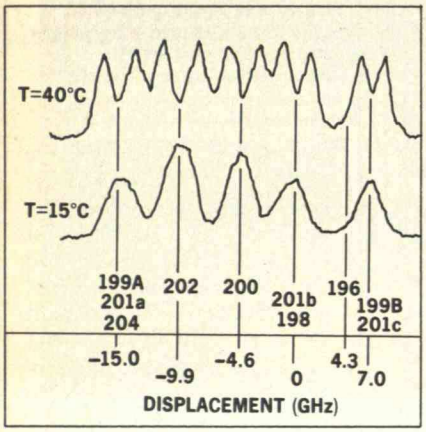
Improvements in fluorescent lamps are on the way, too. As just one example, GTE has discovered how to increase the efficiency of these lamps by about 5%.

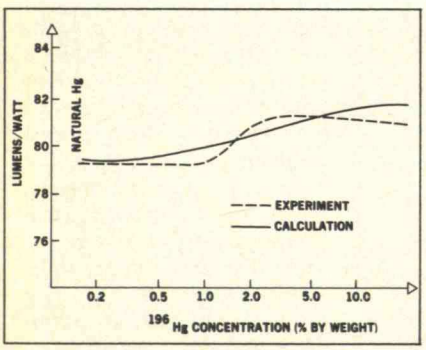
Mercury vapor in the lamp emits



Payload for the GTE space experiment. On the top layer are three HID lamps, whose emissions were investigated in the microgravity environment of the space shuttle.

an old science.





ultraviolet light when it is excited by the electric current. This light is transformed into white when it strikes the phosphors coating the glass tube but some ultraviolet is reabsorbed by the mercury vapor, limiting the lamp's efficiency. GTE researchers have found, however, that by increasing the level of 196 Hg isotope from its naturally-occurring 0.15% to 3.0%, more ultraviolet light escapes to the phosphor. Output improves about 5%.

Light from molecules?

In the future, light may be produced directly from excited molecules in low-pressure lamps. The light spectrum is in broad bands, rather than the narrow-line emission from mercury or sodium atoms.

GTE researchers are investigating ways to produce white light from molecules as the basis for a totally new lamp.

The chemical make-up of the molecules and their behavior in the excited state are undergoing critical studies. In many cases, GTE is applying electrodeless technology with RF power sources as exciters.

This new way of looking at light bulbs promises high-efficiency, long-lived, cool-running light sources with many industrial and residential applications.

The wonderful world of light.

At GTE, we are working on many projects aimed at bringing about the revolution in light. New electrode materials, improved sealants, excimers—these and more are on the GTE research agenda.

The box lists some current papers pertinent to GTE lighting research. For any or all of these, you are invited to write GTE Marketing Services Center, Department TP-L, 70 Empire Drive, West Seneca, NY 14224. Or call 1-800-828-7280 (in N.Y. State 1-800-462-1075).

Pertinent Papers

Convection and Additive Segregation in Metal-Halide Lamp Arcs: Results from a Space Shuttle Experiment
Symposium on Science and Technology of High Temperature Light Sources, Electrochemical Society Meeting, Toronto, 1985

Arc Discharge Convection Studies: A Space Shuttle Experiment
Proceedings of a symposium held at NASA Goddard Space Flight Center, Greenbelt, Maryland, August 1-2, 1984

Energy Conservation Through More Efficient Lighting
Science, Volume 226, pp. 435-436, October 26, 1984

Enhanced HgBr emission at low pressures
Applied Physics Letter 42, May 1, 1983

Bound-free emission in HgBr
Applied Physics Letter 41, November 1, 1982

GTE

Dream Pipe

Some discoveries could only occur to those who pursue lively interests outside their field. Ulrich Kurzweg, an engineering professor at the University of Florida at Gainesville, was investigating the physics behind an experimental "high-frequency ventilation" device used at the university's health center. This device sends some 40 small pulses of air per second into the windpipe of patients such as premature babies who have trouble breathing, and from there manages to get oxygen into their lungs. In studying how pulses of air speeded diffusion of gasses through the thin, almost motionless "boundary layer" of air next to the lungs, Kurzweg had an idea for an industrial device.

He thought he could use the stationary boundary layers that fluids form next to solid surfaces, together with pulsed motions, to move heat. "It's very unlikely that someone studying heat transfer itself would ever have come up with this idea," says Kurzweg, who specializes in fluid mechanics.

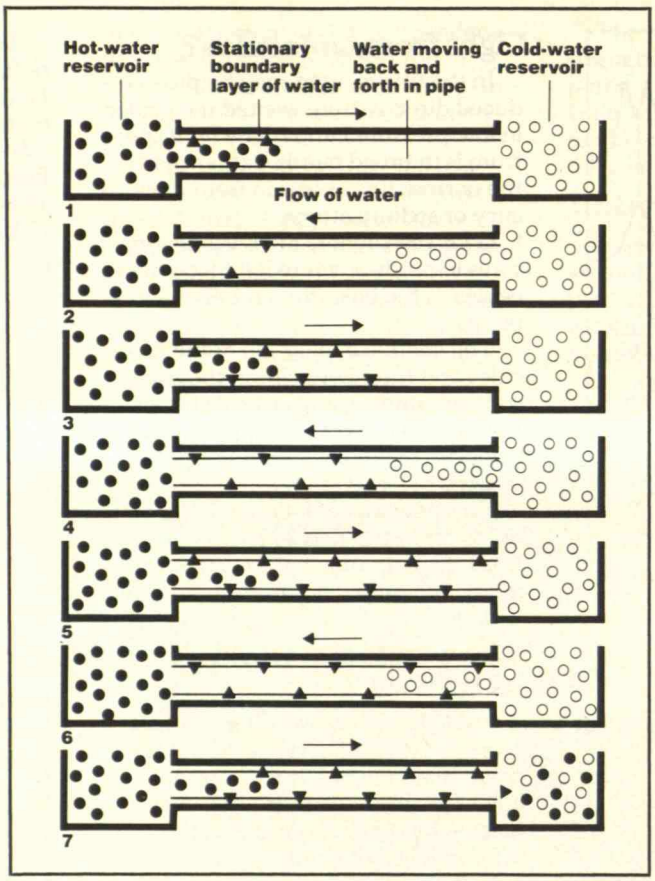
The University of Florida has patented his device, and he expects it to be useful in applications ranging from cooling electrical generators on spacecraft to heating fiberglass in manufacturing.

To demonstrate his device, Kurzweg connects reservoirs of water to both ends of an acrylic pipe stuffed with tiny glass tubes. One reservoir is hot and dyed red, the other is cold and dyed blue; the pipe and capillary tubes are filled with ordinary clear water. Kurzweg turns on an oscillator—in effect a plate that moves rapidly back and forth in one reservoir. The dyed waters surge in and out of the pipe, but not far enough to mix: the red water stays red, and the blue stays blue. Nonetheless, the thermometer attached to the cold reservoir climbs rapidly. "We get heat transfer rates 20 to 30 times greater than if the pipe were a solid copper rod," says Kurzweg, referring to the metal whose high conductivity makes it a benchmark for measuring heat transfer.

The key to the way the invention works is the behavior of the water as it oscillates back and forth in the glass capillaries. Friction prevents the water close to the capillary walls from moving freely, creating a still boundary layer. The water away from this layer flows freely, forming a moving core.

First the oscillator pushes red water from the hot reservoir a third of the way into the capillaries, warming the boundary layer in that section. Then the oscillator pulls the red (but now somewhat less hot) water back into its reservoir. Simultaneously, part of the "shuttle segment"—the clear water that shuttles back and forth in the capillaries—is pulled into contact with the newly heated boundary layer and is itself warmed. The next push sends the warmed part of the shuttle segment down the capillaries, where it heats the next section of the boundary layer.

The process continues: heat is transferred from the moving core to the stationary boundary layer and back to the moving core—down the capillaries to the cold reservoir, raising its temperature. However, the water itself just keeps shuttling back and forth. "I knew on theoretical grounds that the device ought to work," Kurzweg says. "But it wasn't until we saw the thermometer start to climb that we were sure."



Follow the arrows (▲) to see how heat moves in this novel device by passing in and out of the boundary layer of water.

John Orcutt of Combustion Engineering in Stamford, Conn., thinks that Kurzweg's discovery might perform some of the roles now played by heat pipes. These capped cylinders contain a fluid that evaporates and condenses, transfering heat from one end to the other. Kurzweg's invention might, for example, supplant heat pipes in cooling microcircuits such as on supercomputers and some electric generators on spacecraft. Farrokh Kaveh, an engineer at the Owens-Corning Fiberglas Technical Center in Granville, Ohio, hopes to use Kurzweg's invention to solve one of the thornier problems in heating plastic resins used to make fiberglass wool to speed its curing.

A given heat pipe can operate only within a fixed temperature range (depending on the particular fluid that is evaporating and condensing inside). However, Kurzweg's device can operate at any temperature and with any gas or liquid. It is particularly effective because the temperature gradient—the difference in temperature across the thin boundary layer—is so high. In fact, Kurzweg believes his device could transfer heat 100 times faster than the best of today's heat pipes.—*David Kennedy* □

DIAGRAM: OMNIGRAPHICS

Good-bye to the Boll Weevil?

This infamous pest seems doomed as cotton farmers turn to new all-out eradication programs.

The boll weevil has been a scourge to cotton crops since the days of the Old South. The Boll Weevil Eradication Program (BWEP), started in 1983 in North and South Carolina with funding from the U.S. Department of Agriculture and local farmers, took on the ambitious goal of eradicating this infamous pest from those states. The BWEP came close to reaching, if not actually attaining, this goal. Now cotton growers nationwide are considering adopting similar programs, even in states such as Alabama and Mississippi with more extensive weevil populations.

But the BWEP raised legal and social questions. It required every last cotton farmer, even those owning "backyard cotton patches," to participate, says Fred Planer, director of the program. Because of the American tradition of individualism, some farmers balked at letting outsiders tell them how to run their businesses.

Systematic Eradication

The BWEP is similar to integrated pest management (IPM), another approach to controlling harmful insects that is increasingly gaining favor. Both methods call for reducing pesticide use by spraying and otherwise treating fields at critical points in the life cycle of the pest—not, as with conventional methods, according to the growth of the crop. But while IPM merely seeks to control pests to minimize crop damage, the BWEP sought to eradicate all weevils from its target area.

After the cotton had matured in August 1983, aerial sprayings with the pesticide malathion were carried out once every five days over North and South Carolina to reduce weevil populations for the following year. Farmers had used malathion in previous years, but not at the end of the season. The sprayings continued until after the cotton had been harvested; then the stubble was shredded to deprive the weevils of food.

In March 1984 the BWEP staff set pheromone traps, baited with the scent that female weevils release to attract males to mate, in the cotton fields. When the weevil population is low, the traps effectively suppress it, Planer says. When the population is high, the number of weevils caught in the traps indicates just how many there are. Weevils from the traps were dissected to determine their maturity, and the BWEP staff made plans to treat fields where the pests could be expected to survive until the mating season in June.

Originally, staff members planned to use Dimilin, a growth regulator that prevents weevil eggs from maturing normally. It does not affect beneficial insects that control the bollworm, a moth larva unrelated to the boll weevil that lays its eggs in the cotton boll and harms the crop. However, Dimilin is less effective than malathion against the weevil itself. Farmers were skeptical about the efficacy of this growth regulator, so the BWEP staff agreed to use the better-known pesticide. The staff continued to monitor pheromone traps through the season and sprayed wherever

PHOTO: USDA/APHIS

they found weevils.

By August, when the BWEP was again ready to begin the cycle of fall sprayings, only 30 of 8,830 fields in the eradication zone had reproducing weevils. This remarkable success came at a lower cost than the conventional approach to insect control, whereby farmers sprayed their own fields whenever crop damage from the weevils seemed to be mounting. Jerry Carlson, an agricultural economist at North Carolina State University, estimates that the BWEP saved farmers 50 percent of their weevil-related expenses, including both lower pest-control costs and reduced crop losses.

The surprising aspect of the BWEP was less that it proved entymologically sound than that it worked politically. Proponents had to establish a legal framework to enforce participation. To do this they turned to New Deal legislation that established a means for setting limits on the number of acres farmers could plant. Under this law, if two-thirds of them vote for such acreage controls, then everyone can be forced to comply. Organizers of the BWEP concluded that they could use the same legal framework to set up their program.

In January 1983, the two states held referenda on the BWEP. Both received more than the requisite two-thirds majority—but not by much in South Carolina. And after the vote two groups of farmers filed suit against the BWEP.

One group, in Anderson County, S.C., began growing cotton after the program had started and claimed they could not be forced to join it. This group lost its case. However, a second group of six farmers in Clarendon County, S.C., won a case in the lower court charging that the regulations set up by the BWEP do not follow proper legal guidelines. Planer claims that this matter can be easily remedied, and in any case the court ordered the farmers to participate free of charge, pending appeals.

Most farmers are very pleased with the program. In January this year, 93 percent of North Carolina's farmers voted to continue it. That vote was necessary because, as originally conceived, the program was to be completed and the weevils were to be gone by this past June. Planer claims that the weevils have in fact been eradicated from the target area. Jack Bachler, an entymologist at North Carolina State, does not agree that weevils have been eradicated "from a scientific standpoint." But the argument may be academic. Bachler agrees that from a practical point of view, crops suffered no economic damage from the weevil. And Planer admits that new weevils can always migrate into a cleared area, even from across national borders, and he therefore no longer foresees a date when the BWEP will be complete.

The program's achievements are impressive enough that the National Cotton Council has endorsed the idea of adopting it nationwide, and the legislatures in Alabama and Georgia are considering bills to hold referenda on weevil-eradication programs in their states.—*Peter Downs* □

The Saga of the S. P. Lee

The *Samuel P. Lee*, embarked on a year-long marine-geology expedition that traversed the Pacific Ocean from Arctic to Antarctic waters, made a big impression everywhere it went. Taufa'a-hau Topou IV, king of Tonga, threw a royal feast of roast pig. In Vanuatu—a newly independent string of islands 1,200 miles northeast of Australia—Parliament was suspended for the day so the president, prime minister, and other officials could lead a tour for the *Lee*'s international cadre of geologists.

Not everybody was as thrilled by the arrival of the *Lee*. In Christchurch, New Zealand, members of the environmental group Greenpeace loudly protested studies

PHOTOS: U.S. GEOLOGICAL SURVEY

of possible oil reservoirs under the Antarctic Ocean. But the voyage certainly received ample notice.

The expedition has been hailed as a triumph of diplomacy and a scientific gold mine. It has also proved to be an object lesson for scientists on the public payroll who let imagination outstrip budget, and the venture's repercussions still reverberate through the U.S. Geological Survey (USGS).

"Project Deep Sweep" dispatched the 208-foot research vessel, a Navy survey ship on long-term loan to the USGS, to sea with a rotating staff of 20 scientists and 20 crew members. The ship left its berth in San Francisco Bay in August 1983, scheduled to sample and map geologic features on the seabed in mid-ocean regions, U.S. waters, and in the territorial waters of a host of nations.

Scientific dividends of the 40,000-mile voyage were substantial. For example, researchers sampled cobalt-rich manganese crusts on submerged volcanoes in both U.S. and Kiribati waters, and they measured an ominous uplift in Rabaul Harbor in Papua New Guinea that may presage a catastrophic eruption. The scientists also detected high heat flows under the icy waters of the Ross sea that could be linked to a crustal rift slowly rending Antarctica in two.

Getting There First

The *Lee*'s recent trip, as well as a 1982 expedition through the South Pacific, were largely the fruit of artful political maneuvering by two geologists on board—chief scientist H. Gary Greene of the USGS marine geology branch in Menlo Park, Calif., and Alexander "Sandy" MacFarlane of the British Geological Survey, who also held the position of director of geology, mines, and rural water supplies in Vanuatu.

The two met while sharing a room at a geology conference in the French territory of New Caledonia in 1980. The tall, lanky American and the compact, precise Scot listened as a Soviet delegation proposed to conduct a marine survey among the many and mostly small nations of the South Pacific. At the same time, Greene told his companion how funding cuts were keeping the *Lee* idle in California. MacFarlane saw a way to use the Russian bid "to keep this terrific American ship working—down here."

Soon New Zealand and Australia both put pressure on the United States to mount an expedition that would freeze out the Russians. The clincher came in 1981 when Greene met Michel T. Halbouty, an independent Texas oilman and geologist whose fiery temperament is matched only by his influence. Halbouty had been energy advisor to Ronald Reagan during his transition period to the presidency, and had in 1974 put together an international forum of industries and governments called the Circum-Pacific Council for Energy and Mineral Resources.

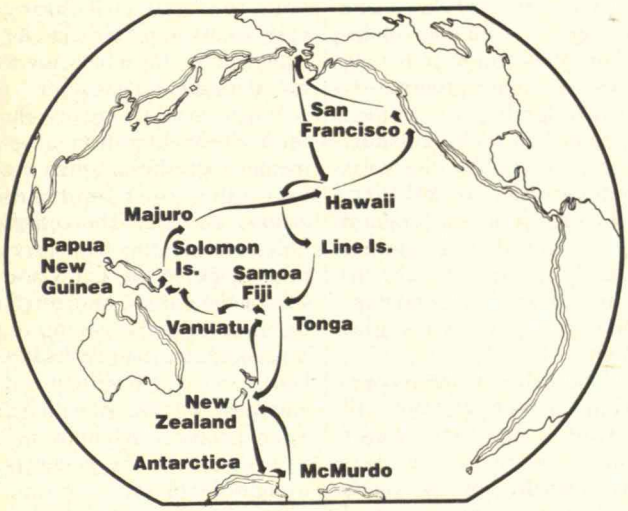
Greene told Halbouty of his difficulty in obtaining backing for a South Pacific voyage. "Halbouty is an excitable guy," Greene recalls. "He said he'd do something about our problem and stormed out." Halbouty headed to the office of then-Secretary of State Alexander Haig. Money was soon released through the U.S. Agency for International Development (AID) to send the *Lee* through the waters of a half-dozen South Pacific nations in 1982. The ocean-girdling Deep Sweep trip was a natural followup stimulated, again, by fears of a similar Soviet initiative.

Funds Unravel

It was this second trip that caused big trouble at home for its organizers. While other sponsoring nations paid some of the costs, most of the funds were to come through the USGS. However, the survey, which customarily funds only studies in U.S. waters, would foot only part of the remaining $10 million to $15 million bill. So David G. Howell, chief of the Pacific marine geology branch, stitched together a patchwork of outside funding pledges from the Navy, the Interior Department's Minerals Management Service, AID, and private industry.

As the ship left the Golden Gate behind, Howell had only enough money in hand for a few month's worth of fuel. His crazy quilt of other money soon began to unravel. The AID funds came more slowly than expected, industrial support for the Antarctic leg didn't materialize, and neither did the Minerals Management funds. At USGS headquarters in Reston, Va., a mid-year audit spat out a scandalous result: because of the *Lee*'s trip, Howell's branch was a staggering $14 million over budget.

The budget collapse struck shortly after Howell had left California to join the *Lee* in Antarctica. That leg was miserable enough—owing to a propellor bent on the ice, an



The *S.P. Lee* carried an international cadre of geologists on a 40,000-mile Pacific expedition (map). Project Deep Sweep was a triumph of diplomacy and a scientific gold mine. But the voyage also depleted federal coffers for marine geology and landed its organizers in hot water.

irreplaceable string of towed instruments nearly lost to an iceberg, and Howell's own frightful seasickness—when an urgent radio message ordered him home immediately. Red-eyed and jetlagged, Howell met in California with a survey auditor who heatedly told him his branch was "out of control." The staff's accounts were frozen for weeks while the affair was sorted out. "We couldn't even buy a pencil," one worker says.

Built-In Risks

Howell has since managed to revive enough of the old IOUs to cut the deficit to a manageable $1 million to $2 million. Indeed, he still thinks the gamble paid off—the trip was completed as advertised. But all is far from well. A recognized expert on continental accretion, Howell is likely to suffer a cloud on his career for some time, and, he adds, "we wound up with a reputation for runaway budgets that is going to be hard to live down." Howell blames it all on the built-in risks of pitting long-range plans against the yearly vagaries of federal funding cycles. Now his branch's inventory of spare equipment is down to almost nothing, and the staff is reduced mainly to desk work.

The *Lee* remains tied to its wharf, a symbol of the federal government's withdrawal from the international geological scene (*see "U.S. Geology: Courting a Crisis" by Charles Petit, July 1985, page 30*). Only one short venture to the seas off Oregon and Washington this summer is scheduled. If nothing else comes along, the stubby exploration vessel is expected to stay right there at the pier for the next few years or to be retired.—*Charles Petit* □

Fighting Fire with . . . Computers

The wildfire burned within sight of Montana's capital last August, one of a chain of fires that stretched across the state. The crew responsible for combating the blaze faced a dilemma: although near Helena, the fire raged in an inaccessible area. With no roads for bringing in needed equipment, the battle would be costly and take the time and energy of many firefighters. If left alone, the fire might burn itself out. Or it might not.

So there at the fire camp, with smokey haze hovering overhead, crew members gathered around a computer. They punched in variables—wind, chance of rain, vegetation, and others. The computer told them that the fire would burn out under those conditions. The computer was right.

That North Hills fire is one of a growing number of incidents that demonstrate how a new computer program—a knowledge-based "expert system," in technical parlance—can reduce the costs and dangers of wildfire. Called BEHAVE, the program was developed by researchers at the U.S. Forest Service's Intermountain Fire Sciences Laboratory in Missoula, Mont.

Hand-held calculators programmed with BEHAVE will be issued nationwide by next year, according to Forest Service officials. For this year's fire season, some foresters carry calculators programmed with an earlier version of the program.

"It takes years for a person to accumulate enough experience to become an expert in predicting the behavior of forest and range fires," say Patricia Andrews and Don Latham, researchers at the fire-sciences laboratory. "However, land-management agencies don't always have the luxury of taking years to develop fire-behavior experts. . . . So we have given fire managers an assistant."

When a wildfire breaks out, the fire-behavior officer, a key member of the fire-fighting crew, flies over or drives around the fire. The officer notes such factors as vegetation, slope of the land, and size of the flames, and enters the data into the computer. The computer then calculates how fast the fire will spread and how intense it will be. Such predictions help the crew determine the best way to fight the blaze.

BEHAVE is proving useful as a management tool as well. The Forest Service and other government agencies can use the system to study the fire potential of a given area. Foresters can play a series of "if-then" games that predict what would happen if a fire started, given local conditions of weather, vegetation, and geography. The agencies can

PHOTO: U.S. FOREST SERVICE

Foresters have a new assistant in fighting wildfires—an "expert system" that predicts how fast the fires will spread and how intense they will be.

then establish minimum requirements for the district's fire-fighting force in order to allocate human and financial resources most efficiently. One Forest Service researcher points out that federal budget cuts have made such planning even more critical, since there are now fewer foresters "waiting for fires."

BEHAVE will also help foresters carry out a relatively new Forest Service policy called prescribed burning. Acknowledging that fires are an integral part of the ecosystem, the agency now allows trained foresters to burn some areas to remove excess flammable material that could trigger a more serious fire later. The foresters also let some wildfires burn if they don't threaten life or property, and then field workers burn out remaining underbrush if nature leaves the job unfinished.

BEHAVE is based on a mathematical formula that was, for experts who had been struggling to predict fire behavior, a breakthrough. Fire is a complex phenomenon; what any given fire does depends on many factors. Scientists had long studied the problem theoretically, investigating the physical principles governing fires. They also studied real fires and tried to correlate their behavior with theory. They sought an equation that would predict how quickly a fire would spread under various conditions.

In the early 1970s, Richard Rothermel, an aeronautical engineer who had become sidetracked into the Forest Service, began studying the problem. He gradually developed a formula that was nearly complete, lacking only an equation covering the process by which fires advance. To remedy that, Rothermel and his colleagues built numerous "fuel beds" with varying combinations of woods, grasses, and shrub. They burned the beds and collected data on how fast the flames spread and what happened to the fuels. "The resulting formula can predict a fire's rate of spread as well as its intensity," Rothermel says. "And the only inputs needed are items that can be measured in the field, such as the type and quantity of fuel and the fuel's moisture content."

Fires Down Under

In Australia, where wildfire is an ever-present and terrifying prospect, one state government is applying the BEHAVE system—modified slightly to reflect local conditions—to land-use planning. By matching vegetation patterns with information on fire behavior, researchers in New South Wales are identifying fire-prone sites. For example, a ridge of mountains in one area proved to be a natural channel for fires. Some officials hope that local governments will soon begin using the model to guide development. "With the model, we can indicate areas where under no circumstances should you put a subdivision," says Bruce Lever, a biologist with the New South Wales Parks and Wildlife division.

If the vegetation is thoroughly mapped, the Australians have shown that computerized predictions of fire-behavior can be very precise. For example, researchers plotted the course of a hypothetical fire at Morton National Park in the south-central part of the country. Not long after, a fire blazed through the park. The map of the actual fire is almost identical to that produced by the computer model.

Such accuracy has already helped settle a court case involving the 1983 "Ash Wednesday" fires that wiped out huge areas. The owner of a pine plantation in the state of Victoria sued the government, claiming that the wildfire would not have reached his property if foresters had earlier set a prescribed fire. (Prescribed burning is used routinely in Australia.) Using the BEHAVE system, however, the government showed that a prescribed burn would have done nothing but delay the wildfire's arrival by 45 minutes. The deliberate fire would have consumed some of the fuel, but not enough to halt the spread of wildfire.—*Susan Walton* □

High Art

Joe Davis is an artist who thinks big—even in his dreams. "I once dreamt we had discovered an asteroid with plumbing," he says, by way of explaining a sculpture composed of steel embedded in rock. "The asteroid's technology was so adaptive that the plumbing was integrated right into it."

Another dream is closer to realization. Using a custom-designed electron gun carried on the space shuttle, Davis hopes to light up the heavens with an art display so large it will make environmental sculptor Christo's 24-mile "running fence" look like a pointilist's dot.

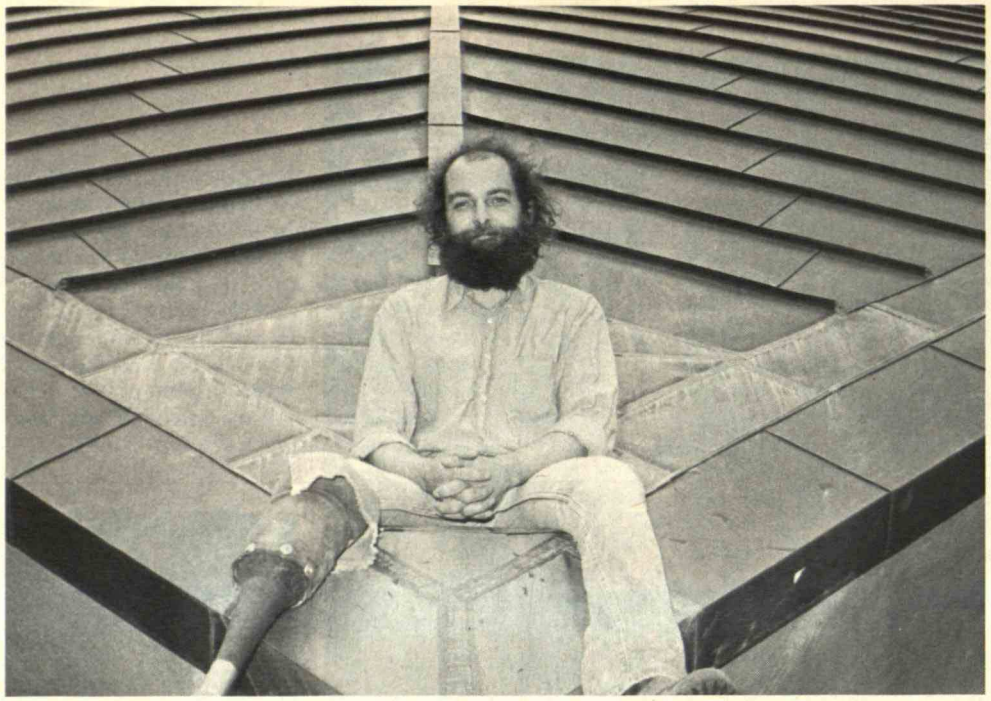
According to theories worked out by Davis and his scientific colleagues at M.I.T., electrons from the gun will excite atoms in the upper atmosphere, causing them to glow much like the Northern Lights. Unlike natural auroras, however, Davis's light show should be visible throughout much of the world. The column of greenish-white light will be about 13 miles long and as wide as a football field, looking like 15 full moons to observers on Earth. The flash will last about a second and a half and be repeated every minute. The show will continue for several shuttle orbits, encircling the planet with intermittent artificial auroras.

***Astro Lisa* reflects Joe Davis's lofty aim for art.**

Davis calls his proposed display "New Wave Ruby Falls," named after Ruby Falls, a popular tourist attraction in Tennessee. "I remember a vacation my family took when I was young," he says. "Everywhere we went we saw signs saying 'See Ruby Falls.' Well, I want everyone to be able to see the display we create."

Davis spoke to me in his studio at M.I.T.'s Center for Advanced Visual Studies, where he is a research fellow. The few canvasses, sculptures, and posters scattered about are vastly outnumbered by tape recorders, televisions, video equipment, and other electronic gadgets. He showed me the electron gun, which was designed at

PHOTO: GARY AGRANAT



Davis: his New Wave Ruby Falls may open soon in your local heavens.

M.I.T.'s High Voltage Laboratory. The white ceramic device is surprisingly small, not much larger than a beer can. The cathode inside, which emits electrons when heated, is only the size of a quarter. "It's amazing," Davis says. "That little thing's got all the electrons you need to light the Earth on a global scale."

The project is made possible through NASA's Getaway Special program, which enables qualified individuals to rent cargo room on the shuttle. Davis heard about NASA's program in 1977, but it took him five years to convince the agency of his project's merits. "When people like Joe first came to us and wanted to do art in space, we told them no, that the program was for science, period," says NASA's Clarke Prouty. "The agency finally decided that someone could do an artistic project as long as it was scientific enough."

Davis claims a lot of credit for the policy change. At first, he says, nobody wanted anything to do with him or his project. "Artists ran around saying, 'It's not art.' Scientists ran around saying, 'It's not science.' I was sort of stuck in the middle." The key to success was "finding a way to express the benefits of my proposal in terms that NASA could appreciate—technological micro-language."

One potential scientific benefit could be a better understanding of the Northern Lights, which are caused by the interaction of the solar wind—a vast stream of electrons and other atomic particles spewing out of the sun—with the Earth's magnetic field and upper atmosphere. "Scientists don't know precisely the correlation between the rate of flow, or flux, of particles coming from the sun and the brightness of natural auroras," says Chathan Cooke, who helped design the electron gun. "But we know fairly well the particle flux that our electron gun generates. So by measuring the brightness of our auroras, perhaps we can better calibrate the natural particle flux from the sun with the luminosity of the Northern Lights."

Since signing a launch agreement with NASA in 1982, Davis's biggest job has been convincing industrial and research centers around the country to participate in the project. He has made a down payment of $1,500 and owes NASA another $15,500 before liftoff. "Getting money for art projects is always a problem," Davis says. "If I have to, I'll get a job at a gas station and float a loan at the bank."

Some bureaucratic obstacles also remain. "His initial paperwork was not substantial enough," says Larry Thomas, of the Goddard Space Flight Center. NASA still wants to see a "payload accommodation requirement," says Prouty. "We're still not sure exactly what he wants to do."

Technological Tradition

Even if Davis raises the capital and completes the paperwork, the question remains: will New Wave Ruby Falls actually work? Chathan Cooke speaks of "certain unknowns that are not fully established." The answer, in other words, is that Davis and his colleagues won't know until they try it.

In view of all the high-tech requirements of his project, I suggested to Davis that he was a far cry from the solitary painter, wandering around the French countryside with easel and pastels. Not so, he responded. "The guy in France was at the cutting edge of his field, working with the best possible pigments. Similarly, Venetian glass of the Middle Ages was so far advanced that we haven't been able to duplicate it in this century," he says. As for Ruby Falls, Davis says, "Only now has it become possible for an artist to work on this scale, in a global context."

Indeed, artists are becoming increasingly aware of "technology and its ramifications in terms of how we see the world," says David Joselit, a curator at Boston's Institute of Contemporary Art. However, he cautions that interesting technological concepts don't always translate into art. "The thought of lighting up the heavens sounds like a neat idea, but the question is whether it becomes more than just an impressive light show. Of course, judging this type of work is incredibly difficult. It may be a technological marvel without moving beyond the level of visual enjoyment. Or it could be incredibly sublime—like a landscape painting, where the landscape itself becomes the painting."

To those proverbial Thomases who might question why he wants to paint the sky, Davis replies, "That would be like someone who came upon the first painter using animal fat, bark, charcoal, or whatever to mark up the wall of a cave. The observer might ask the painter, 'Why do you want to paint that rock? God gave us that rock.' But that's the whole point, the whole purpose: to take something already there and add to it in some way."—*Steven Nadis* □

PHOTO: FRED MIRLIANI

No Endorsement of Star Wars

To their surprise, several U.S. universities—M.I.T. among them—found themselves late last spring being listed by the Department of Defense as members of "consortia" assembled to work on the extraordinary technological demands of the Strategic Defense Initiative (Star Wars) concept.

Foul ball, says M.I.T. President Paul E. Gray.

It's true, Gray says, that some SDI funds are being offered for research at M.I.T. and other universities, and that some ongoing projects previously supported under other Defense Department programs are now being transferred to SDI.

But the "consortia" idea—with inferences that university acceptance of research assignments adds prestige and credibility to the controversial Star Wars program—is wrong.

President Gray made headlines when he told M.I.T.'s commencement audience that he abhors the effort "to use M.I.T. and other universities as political instruments in an attempt to obtain implicit institutional endorsement.

"M.I.T. will not be so used," Dr. Gray declared. Any participation at M.I.T. in SDI-funded research should in no way be understood as an institutional endorsement of the SDI program. □

The Japan Imperative

The Japanese market is hard to crack, and the familiar criteria of profit margins and return on investment are likely to look discouraging. But there is one compelling reason for growth-minded U.S. firms to scramble for a significant presence in Japan, says Professor D. Eleanor Westney of the Sloan School of Management.

That reason is to learn in a timely way what the competition is up to—its new technology and its competitive strategies for putting that technology into the marketplace.

Writing in *Mass. High Tech*, Westney admits that Japan has a well-earned reputation as "one of the most difficult business environments for U.S. firms to penetrate"—because of an "intricate" distribution system, deliberate barriers to foreign goods, high costs of land and labor, and "enormous" cultural and language differences. But don't be put off by these problems, she advises. A firm that faces and understands its competitors on their own turf can respond more quickly and more effectively to their new products and markets. Furthermore, "the most effective mechanism for monitoring Japanese science and technology," says Westney, "is to maintain a research presence in Japan." These factors are especially important in industrial sectors such as high technology, where product lifetimes are short and speed in bringing products to the market at competitive prices can be a key factor in success.

"In the globally competitive high-technology industries of today, the firm that can draw on the knowledge resources not only of its own society but of other leading players in the industry will have an important advantage over less versatile competitors," writes Westney.

It's that idea that motivates the M.I.T. Japan Science and Technology Program of which Westney is associate director—a plan to help U.S. engineering, science, and management students learn more about Japan by living, working, and studying there. □

Transport Logistics

An intensive one-week seminar in Logistics Analysis for Carriers and Shippers, a joint program of the Center for Transportation Studies and the Sloan School of Management, is set for August 5 through 9 in Cambridge. The centerpiece is the "distribution game"—a computer program in which players select manufacturing shipping, warehousing, and inventory alternatives. For further information: Gerard McCullough, Center for Transportation Studies, (617) 253-7970. □

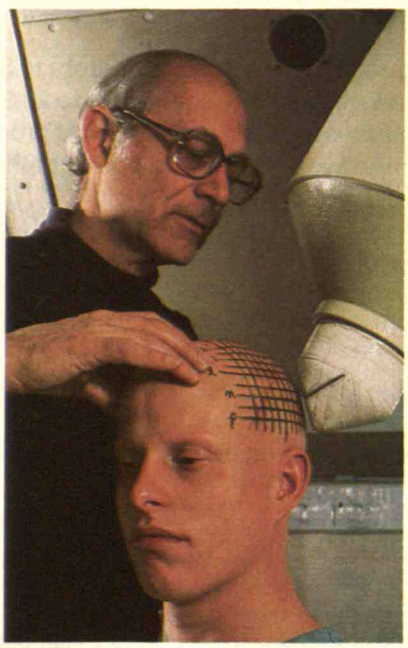
Our organs and tissues produce small magnetic fields. By measuring these fields, researchers hope to improve the diagnoses of ailments ranging from epilepsy to liver diseases.

The Medical Promise of Personal Magnetism

BY PETER GWYNNE

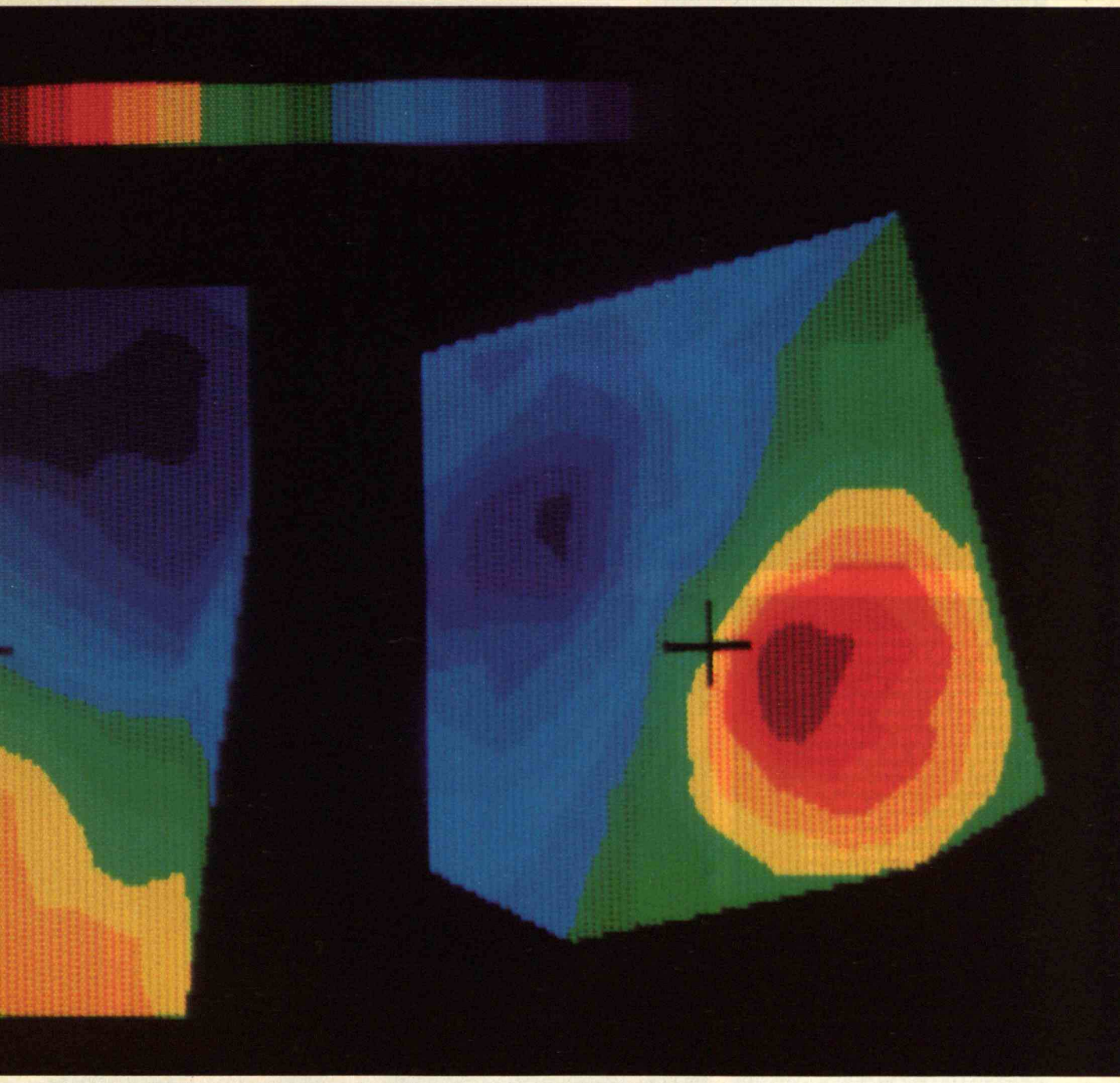
Like horseshoe magnets, electromagnetic generators, and the earth, living things create their own magnetic fields. Through electrical interactions and other processes, the hearts, lungs, livers, and other organs of birds, fishes, and mammals—including humans—produce tiny but detectable changes in the magnetic environment around them.

Until 1970, no equipment was available to measure these minuscule fields effectively. But technical advances over the past 15 years have led to an increasingly sophisticated series of magnetic-field detectors. As a result, biomagnetism, as the phenomenon is known, is promising to take a role in medical diagnosis, helping physicians zero in on a spectrum of ailments ranging from brain disorders to lung diseases to liver conditions. Biomagnetism is also being used to reveal how the healthy human body works and how the normal human brain thinks. "Everyone is rushing to see what can be seen through the new window," declares David Cohen of M.I.T.'s Francis Bitter National Magnet Laboratory, the main pioneer of the discipline.



Several signs indicate the growing significance of biomagnetism. The federal government has plowed several million dollars into biomagnetic research in recent years, and the National Science Foundation and the Defense Department accompany the National Institutes of Health as sources of such money. The number of research groups working on biomagnetism has reached about 40

PHOTOS: DAVID COHEN; CHARLES C. WOOD, YALE UNIVERSITY



Magnetic fields can provide vital clues to the brain's operation. Opposite: M.I.T.'s David Cohen measures the magnetoencephalogram (MEG) of a healthy volunteer, whose bald head aids placement of the detector. Above: These false-color photos compare an MEG map (right) with the more nebulous EEG map.

The key to measuring the brain's magnetic field is a cryogenic sensor known as the SQUID. It is most effective when used in a magnetically shielded room, such as the one at M.I.T. shown above. However, modern equipment can also collect accurate data in unshielded environments. At right, Jackson Beattie and Daniel Barth of UCLA monitor the magnetoencephalogram of a healthy volunteer.

PHOTOS: DAVID COHEN, ALAN LEVENSON

Unlike many diagnostic techniques, biomagnetism is noninvasive and not harmful.

worldwide; two-thirds are involved with practical applications of the technology. And in May, Biomagnetics Technology, Inc. (BTI), of San Diego, the major producer of biomagnetic detectors, wrapped up a deal for more than $5 million in venture capital to expand its operations.

Experts emphasize that biomagnetism is still a research tool rather than an established diagnostic procedure. Even when it joins the diagnostic armamentarium, it will complement other technologies, such as electroencephalography, magnetic resonance imaging, and positron emission tomography, rather than standing alone. However, unlike many other techniques, biomagnetic diagnosis is noninvasive and not harmful. "Patients just lie down on top of a water bag and are lowered under the detector," explains David Farrell of a biomagnetic liver-monitoring procedure that his group developed at Case Western Reserve University. "They often go to sleep."

Three Sources of Biomagnetism

Biological material produces magnetic fields in three different ways. The most common stems from electrical currents generated naturally in the body by muscles and nerves. Magnetic fields are always produced by electric currents. In the human body, the fields of most interest are in the heart and the brain.

Harmless magnetic particles that enter the body by accident, such as particles of iron oxide breathed into the lungs, are another source of personal magnetism. If an outside magnet is used to align the particles and is then removed, the particles maintain a weak but measurable magnetic field of their own.

Even in the absence of particles, biological materials themselves can maintain weak magnetic fields in response to artificial fields applied externally. However, these induced fields last only as long as the external fields that cause them.

Biomagnetic fields are extremely weak. They usually range from about one-hundred-trillionth to one-billionth of a tesla. In comparison, the earth's magnetic field is a huge one-ten-thousandth of a tesla, and a horseshoe magnet exerts one-tenth of a tesla. Measuring the tiny fields against the powerful noise of other sources presented a major challenge. Overcoming it opened up the future of biomagnetism.

Early researchers placed their human subjects in out-of-the-way rural surroundings to avoid any external magnetic effects. Then in 1969, David Cohen devised an effective multilayer shielded room, that effectively blocked all outside magnetic influences. That room was the perfect site for studying human magnetism. An extremely sensitive detector of magnetic fields had just been invented by James Zimmerman of the National Bureau of Standards Laboratory in Boulder, Colo., known as the SQUID, for superconducting quantum interference device. Cohen used the cryogenically cooled sensor in the room, and was able for the first time to pick up the minute fields created by human organs. This was the start of biomagnetism.

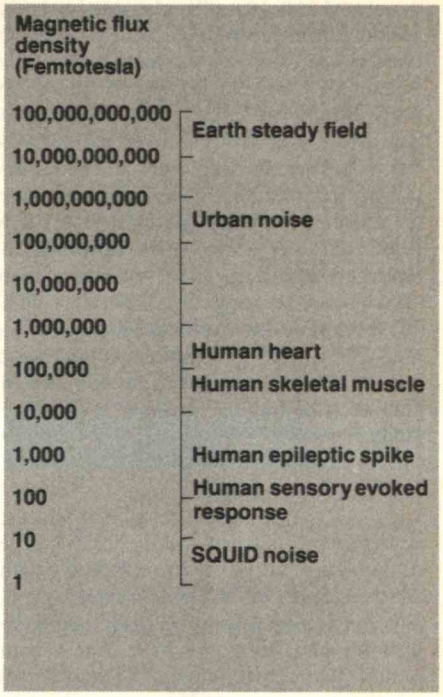
Two years ago, BTI devised a supersensitive form of the device, known as the DC SQUID, that improved the detection capacity even further. The most precise measurements require a shielded room, but the equipment can collect good biomagnetic data without such a room—in a normal hospital environment, for example.

The company is also offering detectors that contain five or seven squids, enabling researchers to look simultaneously at several sites in a specific organ. According to BTI's Steven James, arrays on the drawing board with significantly more channels could reduce the time for a biomagnetic screening from a full day to 15 minutes.

Probing the Brain

The major target of biomagnetic monitoring devices is the brain. The same electric currents that generate electroencephalograms (EEGs) produce magnetic fields that, sensed by SQUIDs, yield magnetoencephalograms (MEGs). However, EEGs and MEGs are not alike. Because magnetic fields are oriented in different directions from electric fields, MEGs sense smaller and fewer sources in the brain than do EEGs; hence, MEGs can monitor the individual sources more clearly. "The MEG appears to yield new information that can be used in clinical diagnosis and in research on the normal brain," explains Cohen.

In particular, MEG seems to complement other techniques in diagnosing epilepsy. The ailment, marked by disturbed electrical rhythms in the brain and manifested by convulsive attacks, affects about 1 percent of Americans. Electroencephalography detects the condition almost unfailingly. But EEGs often cannot locate the focus of the illness in the brain.



The magnetic fields produced by human organs are minuscule compared with the urban magnetic environment and the earth's own magnetic field. However, SQUID detectors have the capacity to pick up meaningful magnetic activity in the body. A femtotesla is one-quadrillionth of a tesla.

It's important to know where epilepsy is centered in patients whose condition does not respond to drugs, and who are therefore candidates for surgery. CAT scans, positron emission tomography, and magnetic resonance imaging fail for many patients. Researchers at a few medical schools occasionally determine the location of the problem by using wires inserted at different points in the patient's head to take an EEG. But that is an invasive process in contrast with MEG, which involves merely placing a detector against the skull. "MEG is a research tool right now," says Jackson Beatty of the University of California at Los Angeles, who has used the technique to study epilepsy and normal brain function in animals and humans. "But when surgery is being contemplated, the potential ability of the technique to provide a three-dimensional focus noninvasively is very interesting."

Lloyd Kaufman of the New York Uni-

One team is exploring ways to differentiate between Alzheimer's disease and other types of dementia.

versity Medical Center also sees promise for the technique in diagnosing other brain conditions, such as dementias and Alzheimer's disease. Alzheimer's seems to involve blockages in the brain's system for retrieving data from long-term memory. In an effort to discover the blockage points, Kaufman's group is designing tests to monitor the magnetic field in the hippocampal formation—the region of the brain involved in the transition from short-term to long-term memory. The NYU team is also exploring ways of using MEG to help differentiate Alzheimer's disease from other dementias, as some forms can be arrested by surgery at an early stage.

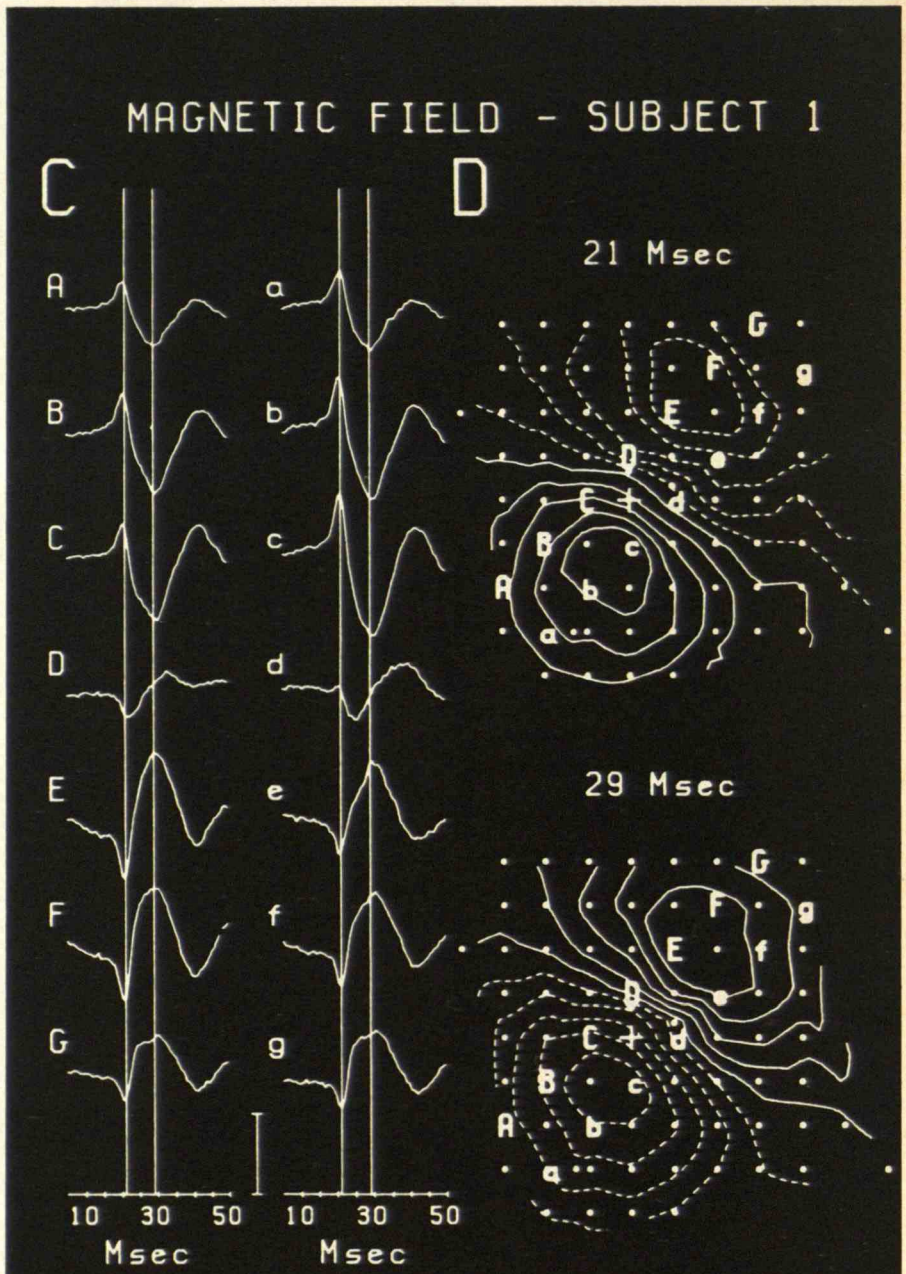
From Livers to Lungs

Two types of genetic disease are the target of biomagnetic work on another organ: the liver. Since 1979, David Farrell's group has worked on a method of detecting the buildup of iron in the liver that accompanies hemochromatosis, a disorder in which excess iron builds up in the liver and other tissues, and thalassemia, an anemia whose victims require continual blood transfusions. The technique uses an external magnet to induce a so-called diamagnetic field in the liver. Any excess iron present as a result of either disease modifies the magnetic field by adding a paramagnetic field—the opposite of the diamagnetic variety. This second field can be readily detected, making possible early diagnosis of hemochromatosis, and early warning of a dangerous buildup of iron owing to blood transfusions in thalassemia victims. "We've succeeded in putting a number on iron concentration in the liver that agrees with direct biopsy results," explains Farrell.

In the short term, this could improve our understanding of iron metabolism in patients with thalassemia. Over the longer term, the work might lead to biomagnetic diagnosis of iron overload.

The team is also using the same technique to investigate overload of iron in the hearts of thalassemia patients—an effect thought to be the specific cause of death for many. However, iron is deposited in a much smaller area in the heart than in the liver, making detection more difficult.

Particles that are ingested and then magnetized by an exterior field show promise in aiding investigations of lung disease. In this case, particles of the iron-oxide mag-



Magnetic wave forms (left) and magnetic contour maps that the wave forms produce (right) are slowly yielding insights into the workings of the human brain. Magnetoencephalography has the advantage over electroencephalography, in that it can focus more sharply on a smaller number of sources of activity within the brain. The contour maps are the sources of false-color images such as that on page 73.

netite act as harmless tracers of the amount of dust in the lungs. The magnetic particles can help reveal the lungs' ability to function under different conditions, without subjecting patients to the risks that accompany radioactive tracers.

In 1979, Cohen and Joseph Brain of the Harvard School of Public Health used the M.I.T. shielded room to study the clearance of dust from the lungs of three heavy cigarette smokers and nine nonsmokers. The measurement indicated that the dust cleared considerably more slowly from the smokers' lungs than it did from the lungs of nonsmokers. However, because of the small numbers of subjects involved, the research generated controversy. Nevertheless, Brain says that other groups have since confirmed the results. More recently, Brain and his colleagues have turned their attention to silicosis, a lung condition produced by inhaling silica dust. They have found that the lungs of exposed animals clear much more slowly than those of unexposed creatures.

Biomagnetism for Basic Biology

Long-term studies of personal magnetism promise to provide fresh insights into how the body works. One effect used in such studies is known as relaxation: the decline over time of a biomagnetic field created by introducing magnetic particles into the body. "We're convinced that the major mechanism responsible for relaxing the field follows the gobbling up of foreign particles by cells connected to the cell skeleton," says Brain. "So the method becomes a way of looking at the motion of cells noninvasively."

Brain studies this effect by injecting magnetic particles into the blood of rats, hamsters, and rabbits, or by persuading the animals to inhale an aerosol. The team can then follow the rate at which the body's garbage-collector cells swallow up the invaders under various conditions.

Another example of basic research on biomagnetism—one that may have practical applications—is under way at Vanderbilt University. Seven years ago, a team headed by John Wikswo set out to develop a mathematical model for the way individual nerves generate magnetic fields. The task required new equipment as well as new ideas. SQUIDs, with their associated cryogenic equipment, are simply too large to detect fields from single nerves less than one millimeter in diameter and no more than two centimeters long.

The team devised a miniature magnetometer shaped like a doughnut that fits neatly around a nerve. The magnetic field of the nerve induces an electric current in the coil, which is then amplified and measured. That technique has improved scientists' understanding of the relationship between the electric and magnetic fields produced by individual nerves. It has also created the possibility of a new method of neurosurgical diagnosis.

When nerves are damaged in an accident, patients and their doctors must wait several months before finding out whether the nerves will regain function without surgery. Neurosurgeons would like to cut down this waiting period by examining the damaged nerves sooner, but the only method now available for doing this is somewhat risky. It involves making electrical measurements on the nerves after exposing them to the air, an action that can dry them and damage healthy nerves.

Now neurosurgeon Vincent R. Hentz at the Stanford University Medical Center plans to use one of Wikswo's doughnut devices to measure the magnetic fields of damaged human nerves. These fields should testify to nerves' health or illness just as effectively as electrical fields. However, the technique works perfectly well in saline solution, thus obviating the need to expose the nerve.

Biomagnetism remains in the realm of experimental science. Nevertheless, the rush of activity in the field and the plethora of results indicate that biomagnetic techniques could soon be recognized as diagnostic tools of major significance.

PETER GWYNNE is managing editor of Technology Review.

CONTINUED FROM PAGE 15

we can acknowledge that present regulations impede innovation on the scale needed to devise, test, and produce as complex a drug as a vaccine. The cohesive regulatory plan recently proposed by the Office of Science and Technology Policy (OSTP) would help integrate the activities of various federal agencies and—where appropriate—encourage a hands-off, positive environment for R&D.

We should also establish a national oversight committee to anticipate the long-term ethical, social, and political implications of genetic engineering. The current law governing research on human subjects stipulates that such a committee should be formed, but none has so far been established.

Furthermore, we need the equivalent of the Orphan Drug Act for vaccines. That legislation offers incentives for companies to develop potentially unprofitable "orphan"drugs for rare diseases. The law could easily be amended to include "orphan vaccines" for diseases common among impoverished people. We must also provide government grants and tax breaks as incentives for companies to embark on essential long-term projects. At a minimum, we need to fund a program for vaccine development and a plan to reduce legal liabilities for companies willing to invest in such products.

Finally, we need to break through the adversarial process that pits environmentalists and social advocates against scientist-entrepreneurs and corporate giants. The biotechnology industry has bowed to the ethic that vaunts the largest, short-term return on the investment dollar. Its critics in turn have tried to introduce every possible roadblock to these developments without offering positive alternatives. One way to bring these groups together would be to encourage firms to add social advocates to their advisory committees. Such committees are now composed almost solely of scientists who have stock and therefore a vested interest in the biotech companies' profit levels.

What is needed now is the long view. The future of the biotechnology industry lies in solving large-scale problems. Profit making and social justice do not have to be incompatible—producing an effective malaria vaccine could yield enormous long-term profits, for example. Only when the biotechnology industry begins to serve basic humanitarian needs will it fulfill its genuinely enormous potential. □

CONTINUED FROM PAGE 17

"the American people have been losing not only their wealth but the freedom to use their resources." He provides a laundry list of reforms to get them back, including restricting the power of the secretary of the interior, ending subsidies for resources such as water, and selling resources at a fair price. Most interesting is his proposal for a "public lands investment trust fund" that would use revenues from public lands to buy more acres to round out national parks, forests, and wildlife refuges.

But the fact is that the public lands are *already* a commons. This is the essence of today's much-vaunted "multiple-use" concept of public-land management. The tragedy of any commons is that their inappropriate use by some despoils the resource for all. FLPMA was meant to counteract this tragedy but was no defense against Watt and his constituency.

Some experts, such as Frank Popper of Rutgers University, would have us get to work not on developing a better FLPMA-cum-public-commons approach, but on rethinking the public-lands strategy from top to bottom. Popper proposes that we manage the public estate as a "national resource reserve" to be used only in a genuine emergency. Because the country's future resource needs are hard to predict, the public lands should be considered a national nestegg for the security of future generations, he holds. In the meantime the lands' natural beauty would be preserved, and only uses that would not interfere with maintaining this reserve would be permitted. That means that coal mining would not be allowed as long as energy sources are readily available elsewhere, but it also means that few areas could be designated as perpetual wilderness. It's a radical idea, although surely less radical than what Watt had in mind.

This Land Is Your Land provides an important reminder of just how defenseless our public lands really are. Yet Shanks doesn't strike out into new intellectual territory and that's what we, as part owners of the public estate, need to do lest the decimation of our inheritance continue unabated. Horror stories are no substitute for hard thinking, and may even inhibit the search for useful solutions to what some consider one of the major unresolved policy issues of our time. □

CHARLES E. LITTLE, a Washington, D.C.-based writer and policy analyst, is editor of American Land Forum.

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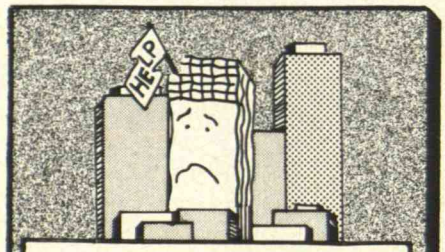

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